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NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. HORSEYS POND DAM (DE 00022). NANTI--ETC(U)
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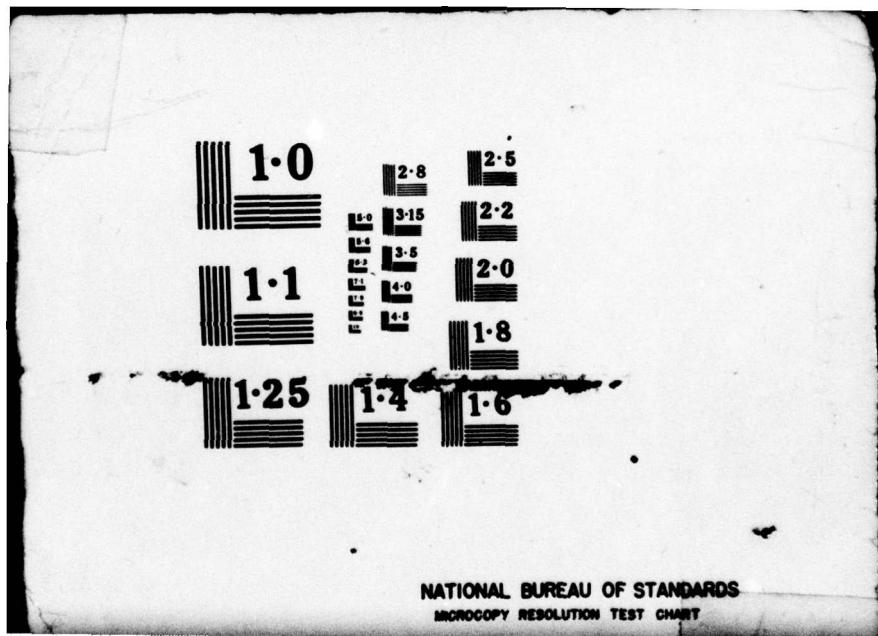
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3 NANTICOKE RIVER BASIN
LITTLE CREEK, SUSSEX COUNTY
DELAWARE

LEVEL II

HORSEYS POND DAM
DE 00022

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

Horseys Pond Dam (DE 00022). Nanticoke River
Basin. Little Creek, Sussex County, Delaware.
Phase 1 Inspection Report.

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(15) DACW61-78-C-0124

(10) Thomas Tyler/Moore

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE--2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

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9 MAY 1979

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Horseys Pond Dam in Sussex County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Horseys Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate since 53 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is the 100-year Flood). To insure adequacy of the structure, the following actions, as a minimum, are recommended:

- a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.
- b. Within three months from the date of approval of this report, a program should be initiated to monitor the seepage occurring on the east and west side of the box culvert so that significant changes in seepage flow can be noted. The seepage should be monitored every three months for a period of three years, and every six months thereafter.
- c. Within six months from the date of approval of this report the area between the spillway and the box culvert entrance should be cleaned of all debris. Periodic visits should be made every six months to prevent further accumulations of debris.

NAPEN-D

Honorable Pierre S. DuPont

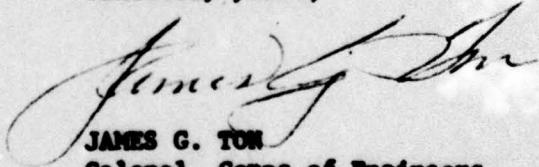
d. Within one year from the date of approval of this report an annual inspection program should be initiated to enable the owner to notice variations in appearance of specific portions of the dam. It is recommended that the owner use a check list similar to the visual inspection check list included in this report.

A copy of the report is being furnished to Mr. Austin P. Olney, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely yours,



JAMES G. TOM
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies Furnished:

Mr. Austin P. Olney, Secretary
Delaware Department of Natural Resources and
Environmental Control
Edward Tatnall Building
Dover, DE 19901

Mr. William R. Ratledge, Director
Division of Soil & Water Conservation
Delaware Dept. of Natural Resources & Environmental
Control
Edward Tatnall Building
Dover, DE 19901

HORSEYS POND DAM (DE00022)

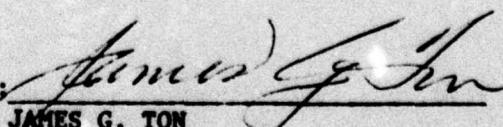
CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 8 December 1978 by Thomas Tyler Moore and Lippincott Engineering Associates, joint venture under contract to the U.S. Army Engineer District, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

Horseys Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate since 53 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is the 100-year Flood). To insure adequacy of the structure, the following actions, as a minimum, are recommended:

- a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.
- b. Within three months from the date of approval of this report, a program should be initiated to monitor the seepage occurring on the east and west side of the box culvert so that significant changes in seepage flow can be noted. The seepage should be monitored every three months for a period of three years, and every six months thereafter.
- c. Within six months from the date of approval of this report the area between the spillway and the box culvert entrance should be cleaned of all debris. Periodic visits should be made every six months to prevent further accumulations of debris.
- d. Within one year from the date of approval of this report an annual inspection program should be initiated to enable the owner to notice variations in appearance of specific portions of the dam. It is recommended that the owner use a check list similar to the visual inspection check list included in this report.

APPROVED:


JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 9 May 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM - Horseys Pond Dam ID #DE00022

STATE LOCATED - Delaware

COUNTY LOCATED - Sussex

STREAM - Little Creek

DATE OF INSPECTION - 8 December 1978

Assessment of General Condition of Dam

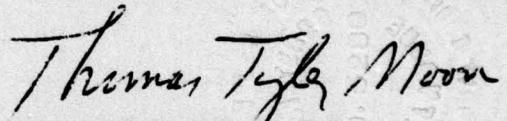
* Horseys Pond Dam was found to be in good overall condition at the time of inspection. The visual inspection and review of engineering data indicate no deficiencies adverse to the dam's adequacy. However, the spillway has the capacity to pass 52% of the routed 100-year flood prior to overtopping of the dam, and is therefore considered hydraulically inadequate.

* To insure adequacy of the structure, the following actions are recommended:

- 1) A further study should be performed to determine the feasibility of increasing the spillway capacity. It is recommended that the study be completed in the near future.

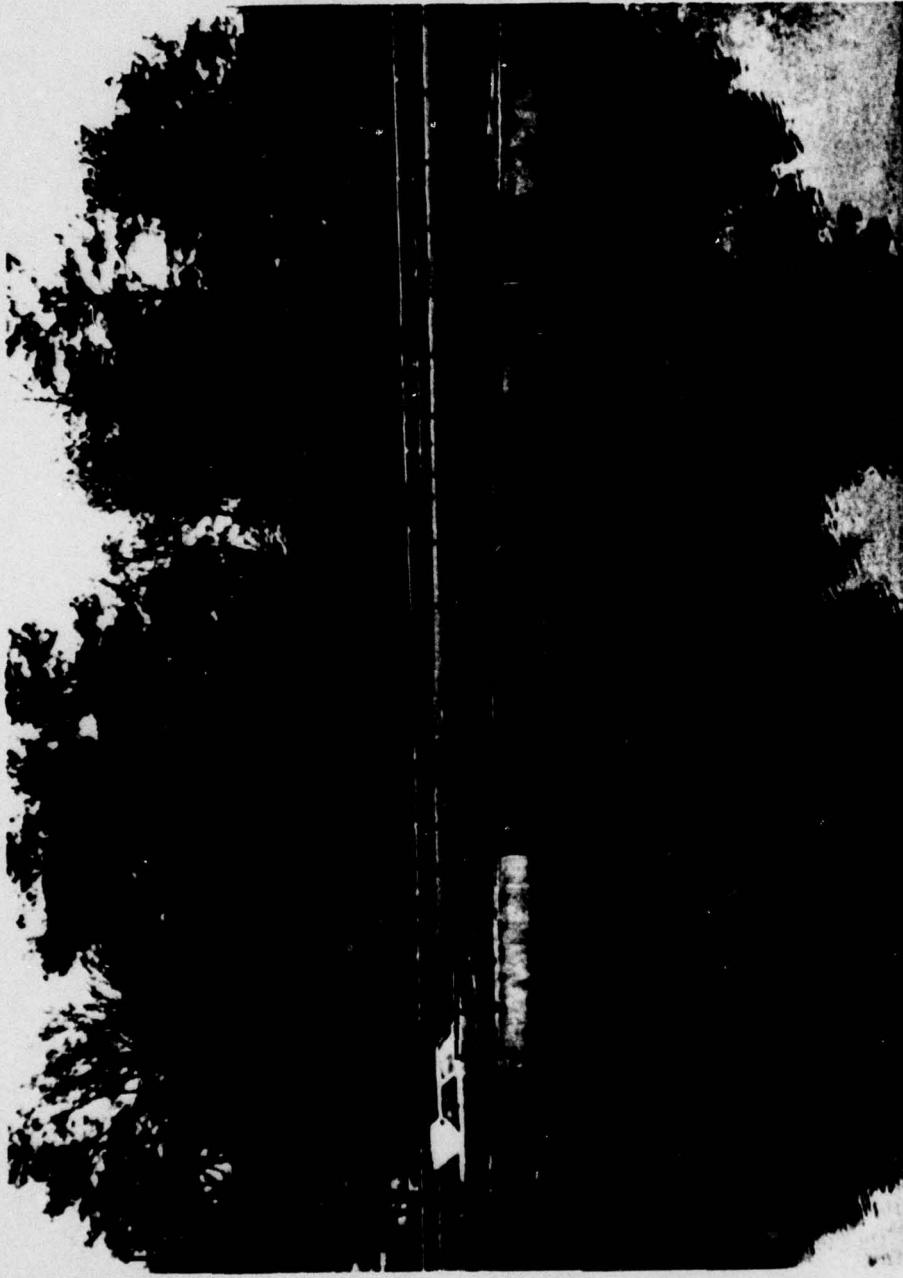
- 2) The seepage occurring on the east and west side of the box culvert should be monitored so that significant changes in seepage flow can be noted. The seepage should be monitored every three months for a period of three years, and every six months thereafter.
- 3) The area between the spillway and the box culvert entrance should be cleaned of all debris. This should be done soon. Periodic visits should be made every six months to prevent further accumulations of debris.

MOORE & LIPPINCOTT - ENGINEERS



Thomas Tyler Moore, P.E.
Project Manager

TTM:lg



OVERALL VIEW OF DAM

DEC. 7, 1978

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PLATES

**LOCATION MAP
PLAN, SECTIONS, & PROFILE OF DAM
GEOLOGIC INFORMATION**

**PLATE 1
PLATES NO.
2 through 12**

APPENDICES

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigation, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test

flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: HORSEYS POND DAM
ID # DE 00022

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority - The Dam Inspection Act, Public Law 92-367, dated August 8, 1972, provides for the report herein. The inspection of Horseys Pond Dam was initiated under Contract DACW61-79-C-006 with the Department of the Army, Philadelphia District, Corps of Engineers by the engineering firms of Thomas Tyler Moore and Lippincott Engineering Associates under a joint venture.
- b. Purpose of Inspection The purpose of the inspection is to evaluate the general condition of Horseys Pond Dam and bring to the attention of the owner those conditions which are a threat to the public. The National Inventory of Dams will be updated by the data accumulated during this inspection.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances - Horseys Pond Dam consists of an overflow structure fronting a double cell box culvert under the roadway embankment of Route 24, a 2 lane paved road. The roadway embankment extends approximately 130 feet west of the overflow structure and 50 feet east of the overflow structure. The overflow structure is 48 feet wide.

NAME OF DAM: HORSEYS POND DAM

Horseys Pond varies in depth, but according to the Division of Fish and Wildlife, State of Delaware, the pond depth at the upper end is approximately six inches and the maximum depth occurs at the dam. Our field measurements indicated a pond depth at the dam of 11 feet.

Horseys Pond extends 6,000 feet upstream of the dam axis. The banks are moderately sloped and well vegetated.

One house exists immediately downstream on the west side of the stream, approximately 9 feet above the streambed.

- b. Location - Horseys Pond Dam is located on a tributary known as Little Creek approximately 10,000 feet downstream (north) of the intersection of Meadow Branch and Holly Branch tributaries, and 6,000 feet upstream (south) of its confluence with Broad Creek in Sussex County. Horseys Pond Dam is located at the southwest fringe of the Town of Laurel.
- c. Size Classification - The maximum height of the dam (top of roadway) is 18 feet. The maximum reservoir volume at the top of dam is 912 acre-feet. Therefore, as determined by the criteria in the "Recommended Guidelines for Safety Inspection of Dams", the size category of the dam is "Small", i.e., the height is less than forty feet and the storage volume is less than 1,000 acre-feet.

NAME OF DAM: HORSEYS POND DAM

d. Hazard Classification - Visual inspection of the downstream channel indicates that breach of the dam would not cause excessive damage to the downstream residence. Therefore, as determined by the criteria in the "Recommended Guidelines for Safety Inspection of Dams", Horseys Pond Dam is considered a Significant Hazard Dam.

e. Ownership - The State of Delaware

f. Purpose of Dam - The purpose of the dam is to impound water for recreational purposes. The prime activity is fishing.

g. Design and Construction History - The overflow structure fronting the box culvert under Route 24 was constructed in 1956 according to the State Division of Fish and Wildlife. "As Built" drawings do not exist for the overflow structure. According to our survey, additional lifting logs were installed so as to raise the pond elevation by 1.8 feet. This action, according to the Division of Fish and Wildlife, was necessary so that many of the tree stumps on the upper end of the pond would be covered by water.

Information on the design and construction history of the box culvert and embankment was not available.

h. Normal Procedures - The dam is controlled by the Division of Fish and Wildlife for the State of Delaware. According to Fish and Wildlife, the pond has been partially drained on occasion so as to allow home owners upstream to build bulkheads and/or improve grading on their property.

NAME OF DAM: HORSEYS POND DAM

Since construction of the overflow structure and development of the pond there have been no recorded overtoppings of Route 24. The pond level, however, is controlled by employees of Fish and Wildlife who live within two miles of the dam. In anticipation of a severe rainfall, stop logs are raised.

1.3 PERTINENT DATA

a. Drainage Area - 15.35 square miles.

b. Discharge At Damsite - Maximum known flood at damsite is unknown.

Warm water outlet at pool elevation: None

Diversion tunnel low pool outlet at pool elevation: N/A

Diversion tunnel outlet at pool elevation: N/A

Gated spillway capacity at pool elevation: N/A

Gated spillway capacity at maximum pool elevation: N/A

Ungated spillway capacity at maximum pool elevation: 3106 cfs

Total spillway capacity at maximum pool elevation: 3106 cfs

Total spillway capacity at top of dam (top of roadway): 1609 cfs

c. Elevation (feet above Mean Sea Level (M.S.L.)) -

Top Dam (Top of Roadway): 24.4 ft. M.S.L. (minimum)

Maximum pool-design surcharge: 25.6 ft. M.S.L.

Full flood control pool: N/A

NAME OF DAM: HORSEYS POND DAM

Normal Pool:	18.6 ft. M.S.L. +
Spillway Crest (ungated):	18.4 to 18.8 ft. M.S.L.
Spillway Crest (gated):	N/A
Upstream portal invert diversion tunnel:	N/A
Downstream portal invert diversion tunnel:	N/A
Streambed at centerline of dam:	6.2 ft. M.S.L.
Maximum tailwater:	Tailwater controlled by downstream channels and bridges.

d. Reservoir (feet) -

Length of Maximum Pool - 10,000 feet

Length of Normal Pool - 6000 feet

Length of Flood Control Pool - N/A

e. Storage (acre-feet) -

Normal Pool - 346

Flood Control Pool - N/A

Top of Dam - 912

Design Surcharge - 1057

f. Reservoir Surface (acres) -

Normal Pool - 68

Top of Dam - 110

Flood Control Pool - N/A

Maximum Pool - 133

Recreational Pool - 68

NAME OF DAM: HORSEYS POND DAM

g. Dam -

Type - Earth-fill embankments and concrete bridge/spillway with wooden stop logs

Length - 180 feet of earth-fill, 48 feet of concrete bridge/spillway

Height - 18 feet

Top Width -47 feet +

Side Slopes - 3H to 1V Upstream; 2H to 1V Downstream

Impervious Core: Unknown

Cutoff: Unknown

Grout Curtain: Unknown

h. Spillway -

Type - Wooden stop logs between concrete piers

Length of Weir - 9 openings at 4.5 feet+ = 40.5 feet total

Crest Elevation - 18.4 to 18.8 feet M.S.L.

Retaining Wall Elevation - varies (see plan)

Gates - None

Upstream Channel - None

Downstream Channel - twin 9' x 7.5' box culvert discharging into stream channel

i. Regulating Outlets - Wooden stop logs may be added or removed as desired.

j. Design & Construction - The spillway and additional earthen embankment was added adjacent to the existing box culvert and roadway embankment of Route 24 by the State of Delaware Dept. of Transportation in 1956.

NAME OF DAM: HORSEYS POND DAM

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Drawings available from the Delaware State Highway Department adequately define the dam as it stands today. There are six drawings outlining the construction of an overflow dam to be attached to an existing two-cell box culvert under Route 24. Also included is a seventh drawing showing drainage along Route 24 at the dam. The various drawings, although not noted as being "As-Builts", have been verified by our survey crew, and except for the modifications marked on the drawings, are true and correct. (See visual inspection for modification, Section 3.1b.) A description of each drawing is as follows (See Plates, Appendix B):

Plate 2

This drawing serves as cover sheet, giving location of dam and index of the following sheets.

Plate 3

This drawing is entitled, "General Plan", giving grading along upstream side of roadway and general descriptions of the dam structure.

Plate 4

This drawing is entitled, "Layout and Masonry Details", giving details for attachment of overflow structure to box culvert.

Plate 5

This drawing is entitled, "Layout of Reinforcing Steel", showing reinforcing for spillway wingwalls and splashway floor.

NAME OF DAM: HORSEYS POND DAM

Plate 6

This drawing is entitled, "Structural Steel and Creo. Timber Structures", giving details of pedestrian bridge.

Plate 7

This drawing is entitled, "Sheet Piling Plan and Borings", giving foundation plan, details, and soil descriptions.

Plate 8

Drainage plan and profile of Route 24 at dam site.

2.2 CONSTRUCTION

The available data on construction uncovered for this report came from drawings supplied to us by Delaware State Department of Transportation and conversations with the Delaware Division of Fish and Wildlife.

The dam was constructed incorporating an existing box culvert under Route 24. Approximately 23 feet south of the box culvert, precast concrete columns were erected and horizontal struts were attached to the top of the columns and top of existing culvert. Stop logs were then placed between the columns to dam-up the existing 15-feet wide stream. Fifteen-feet long steel sheet piles were driven to support the new columns and retaining wingwalls that now adjoined the box culvert on the upstream side.

Thus, the existing roadway embankment became a dam. Data on the construction of the existing embankment was not available.

NAME OF DAM: HORSEYS POND DAM

2.3 OPERATION

The dam is operated by the Division of Fish and Wildlife, State of Delaware.

During periods of significant rainfall, the lake level is controlled by adjusting the stop logs.

2.4 EVALUATION

- a. **Availability** - The fact that engineering data in the form of computations are not available is discussed in Section 7.
- b. **Adequacy** - The adequacy of the information available on the drawings to assess the safety of the dam is discussed in Section 7.
- c. **Validity** - The validity of the drawings assembled for this report are discussed in Section 7.

NAME OF DAM: HORSEYS POND DAM

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General - Horseys Pond Dam was found to be in good overall condition at the time of inspection. The problems noted during inspection are considered minor in nature.
- b. Dam
Earthfill/Embankment - Seepage was observed on the downstream side of the box culvert at the junction of the earth embankment and the ends of the culvert wingwalls. Seepage was barely noticeable on the east side and a trickle was noted on the west side.
Spillway - The spillway was found to be in good overall condition at the time of inspection. Minor concrete deterioration was noted just below the water line in the concrete piers supporting the stop logs in the spillway.
- c. Appurtenant Structures - Debris in the form of tree stumps and large metal drums was noted at the upstream end of the box culvert under the Route 24 roadway.
- d. Reservoir Area - Only that portion of the reservoir bounded by the dam was accessible. All other portions of the reservoir would require access by boat or passage through private property. However, it appeared from the downstream location that sloughing of the heavily vegetated, moderately steep bank, was not occurring. No significant accumulation of silt was noticeable.

NAME OF DAM: HORSEYS POND DAM

e. **Downstream Channel** - The spillway overflows onto a concrete splashway forty-seven feet wide, which then funnels into a double box culvert consisting of two openings, 9'-0"x7'-6". The box culvert extends under Route 24 and empties into a narrow meandering channel. The immediate downstream channel appears to have been recently reshaped and regraded. A small island was constructed with walkway bridges leading to the embankment on either side. The banks are well graded and vegetated. The timber bulkhead along the stream is in need of some repair although the integrity of the bulkhead is not essential to the functioning of the dam. The lowest home located on the banks of the immediate downstream channel is approximately 9 feet above the streambed.

3.2 EVALUATION

- a. The need to monitor the seepage occurring on either side of the box culvert will be discussed in Section 7.

- b. The need for a general clean-up of the culvert will be discussed in Section 7.

NAME OF DAM: HORSEYS POND DAM

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Horseys Pond Dam is operated by the Division of Fish and Wildlife, State of Delaware. When significant rainfall is anticipated, the stop logs are adjusted to control pond elevation.

4.2 MAINTENANCE OF DAM

Maintenance of the roadway embankment and box culvert is the responsibility of the Department of Transportation, Division of Highways. According to the Bridge Engineer this type of structure is inspected every two years.

Maintenance of the overflow structure and spillway adjacent to the box culvert is the responsibility of the Division of Fish and Wildlife. There is no formal or systematic maintenance program at the present time. Maintenance is on an "as-needed" basis.

4.3 MAINTENANCE OF OPERATING FACILITIES

The stop logs of the overflow structure are maintained by the Division of Fish and Wildlife on an "as-needed" basis.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

There is no warning system in effect.

4.5 EVALUATION

- a. The need for a warning system is discussed in Section 7.
- b. The need for a formal maintenance program is discussed in Section 7.

NAME OF DAM: HORSEYS POND DAM

SECTION 5 - EVALUATION OF HYDROLOGIC AND HYDRAULIC FEATURES

5.1 EVALUATION OF FEATURES

a. Design Data - The only design data available for the hydrology of the watershed was listed on the design drawings of the dam prepared by the State Department of Transportation. This listed the size of the watershed as 14.6 square miles and the design flow as 900 cfs. For the purpose of this report, the data presented in this report supercedes the hydrologic data listed on the design drawings. For the hydrologic evaluation used in this report, watershed parameters measured from USGS 7.5 minute quadrangles were used with Snyder coefficients and loss rates specified by the Corps of Engineers to compute peak inflows to the pond. The HEC-1 DB computer program was used to compute the inflow into the pond and to perform the flood routing through the pond.

The dimensions of the dam and spillway as shown on the design plans prepared by the State Department of Transportation were verified by a field survey. Basically the dam was constructed as designed. The only significant difference from the design drawings was that additional wooden stop logs had been placed in the dam to raise the normal pool elevation. The spillway capacity was calculated from the field survey information by standard engineering methods. A typical cross-section of the stream channel below the dam and box culvert under Route 24 was also measured in order to calculate the tailwater on the box culvert from the channel.

NAME OF DAM: HORSEYS POND DAM

Based on the size and hazard potential classification for this dam, the recommended spillway design flood is 50 years to 100 year. For evaluating the adequacy of the spillway the 100-year flood was used as the SDF.

- b. Experience Data - No measurements of outflows from the dam or flows within the watershed of the dam are available.
- c. Overtopping Potential - From the HEC-1 DB Program, the peak inflow to the pond for the SDF equals 3271 CFS. After routing this SDF through the pond the peak outflow was 3106 CFS. The maximum water surface elevation of 25.6 would overtop the low point of the roadway of Route 24 by 1.2 feet.

The spillway capacity at the low point of the roadway (elevation 24.4) is 1609 CFS, which is equivalent to 52 percent of the routed SDF. A rating curve for the spillway and a summary of the routings through the pond is included in Appendix D.

- d. Emergency Drawdown - The water in the pond may be drained by removing the wooden stop logs from the spillway. The maximum flow thru the spillway area would be about 1800 cfs with the water surface at normal pool Elevation 18.6. With no inflow it would take at least 22 hours to drain the reservoir.

NAME OF DAM: HORSEYS POND DAM

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation - No structural inadequacies were noted during the visual inspection of the dam.
- b. Design and Construction Data - No computations have been made available for checking the stability of the embankment, spillway or box culvert structures. However, past performance of these structures and our visual inspection reveal no significant structural inadequacies.
- c. Operating Records - Operating records have not been kept for Horseys Pond Dam.
- d. Post-Construction Changes - No modifications to the dam have been made since construction in 1956.
- e. Seismic Stability - Horseys Pond Dam is located in Zone 1 of the Seismic Zone Map of the United States. Experience has shown that structures having adequate static stability will also have adequate stability under seismic activity. Thus, the dam is considered stable under seismic loading.

NAME OF DAM: HORSEYS POND DAM

SECTION 7 - ASSESSMENT/RECOMMENDATIONS,
PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. **Safety** - The dam has been inspected visually, in accordance with procedures by the Corps of Engineers for a Phase I Report. Since no engineering data was available for review, our assessment is subject to those limitations inherent in a visual inspection.

The spillway at maximum capacity can pass 52% of the routed Spillway Design Flood. Although Horseys Pond Dam is a Significant Hazard Dam (see Sec. 1.2 d), further studies are recommended to determine the feasibility of increasing spillway capacity.

Seepage occurring on the east and west side of the box culvert does not present a piping or stability problem with respect to the embankment as long as the current rate of flow (trickle) remains unchanged. It is recommended that this seepage be monitored every three months for the next three years, and every six months thereafter.

Based upon information supplied to us by the Delaware Department of Transportation, an accurate independent assessment of the concrete overflow structure was not attempted since "as-built" drawings and computations do not exist. However, based upon past record of performance and our visual inspection, no potential stability problem conditions are evident that would indicate a potential stability problem.

NAME OF DAM: HORSEYS POND DAM

- Based upon the location of downstream houses on high ground, no warning system is deemed necessary.
- An annual inspection program is needed so as to enable the owner to notice variations in appearance of specific portions of the dam. It is recommended that the owner use forms similar to the federal visual inspection form included in this report.

b. **Adequacy of Information** - No additional information is needed to complete an assessment of the safety of the dam.

c. **Urgency** -

- A study to determine the feasibility of increasing spillway capacity should be completed in the near future.
- Seepage occurring on the east and west side of the box culvert should be monitored every 3 months for a period of 3 years and every six months thereafter.
- It is recommended that all debris be removed from the dam site soon so as to avoid a build-up between the overflow structure and box culvert. This should be inspected every six months and cleaned as necessary.

d. **Necessity for Additional Data/Evaluation**

As demonstrated in Section 7.1 a, additional evaluation is recommended.

NAME OF DAM: HORSEYS POND DAM

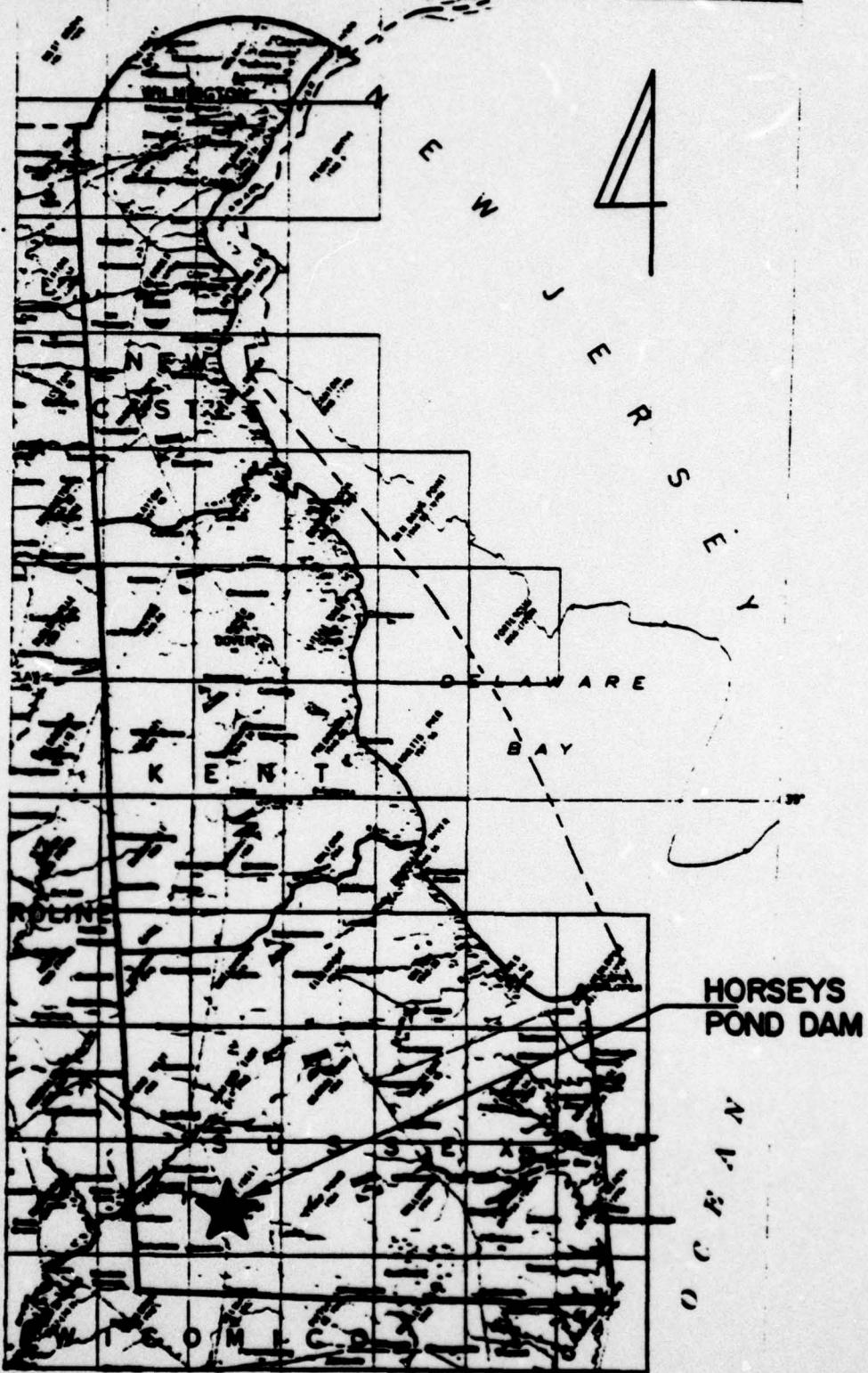
7.2 REMEDIAL MEASURES

a. Alternatives - As part of the recommended further study (see Section 7.1) regarding increasing the spillway capacity, the following alternatives should be investigated as part of that study:

1. Lower the normal pool elevation of the pond.
2. Armoring the downstream embankment of route 24 at the low point where it would be overtopped.

NAME OF DAM: HORSEYS POND DAM

PLATES



LOCATION MAP

HORSEYS POND DAM
PLATE I

THE STATE

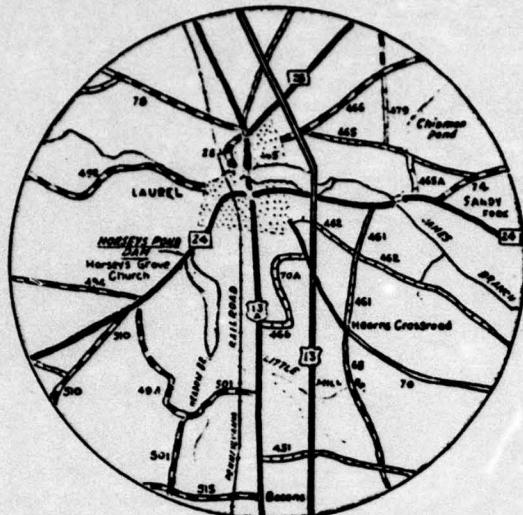
STATE HIGHW

P

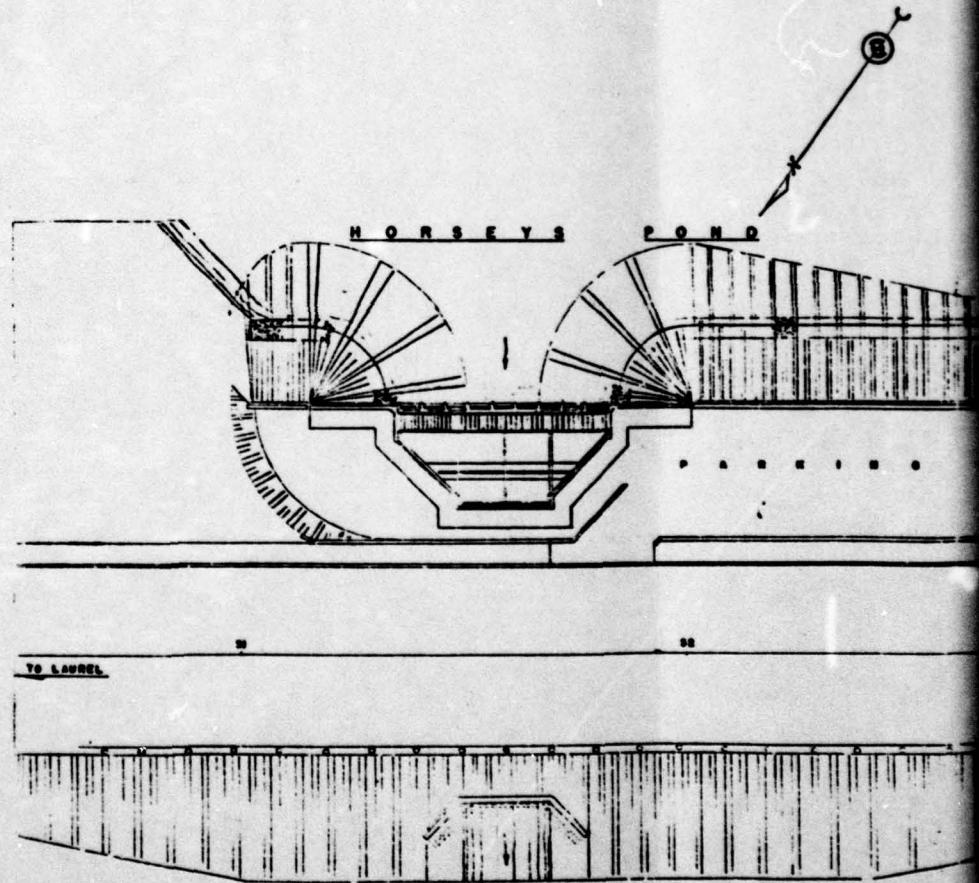
CONSTRUCTION
STA. TO STA.
FEET:

SCALE: PLAN: 1 IN. = FT.
PROFILE: HOR. 1 IN. = VERT. 1 IN.

FEDERAL

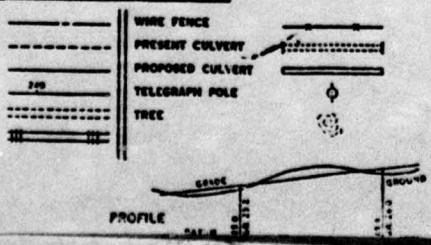


SCALE 1:2500



CONVENTIONAL SIGNS

COUNTY LINE
TO TOWN LINE
OF WAY LINE
CENTRE LINE PROPOSED ROAD
MACADAM, TRAVELLED ROAD
TROLLEY OR RAILROAD



INDEX OF SHEETS

SHEET NO. 1 TITLE SHEET
2 TYPICAL SECTION
2 PLAN AND PROFILE
3-6 BRIDGES STRUCTURES
6 QUANTITIES
7 STANDARDS - T'

OF DELAWARE



AY DEPARTMENT

PLAN
FOR

OF CONTRACT N° 1459

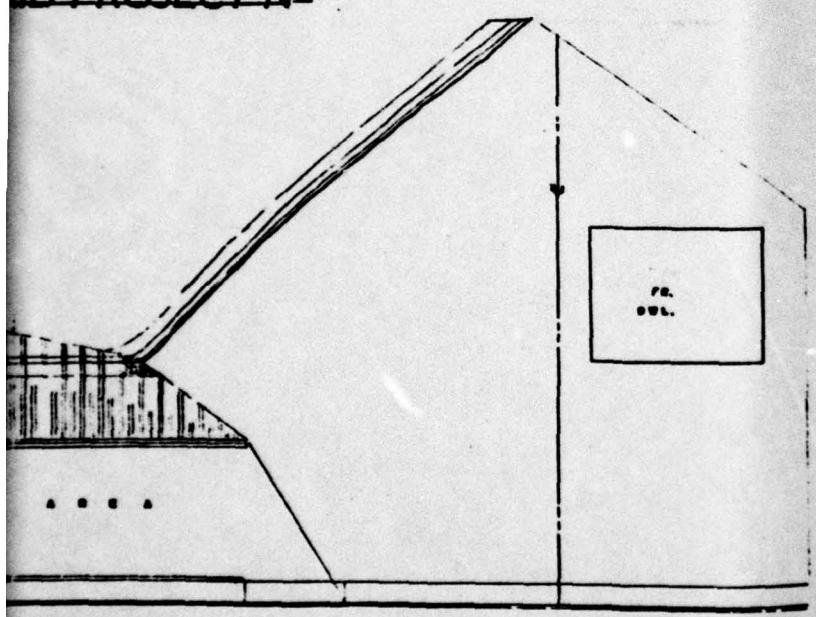
A.

MILES

T.

FT.

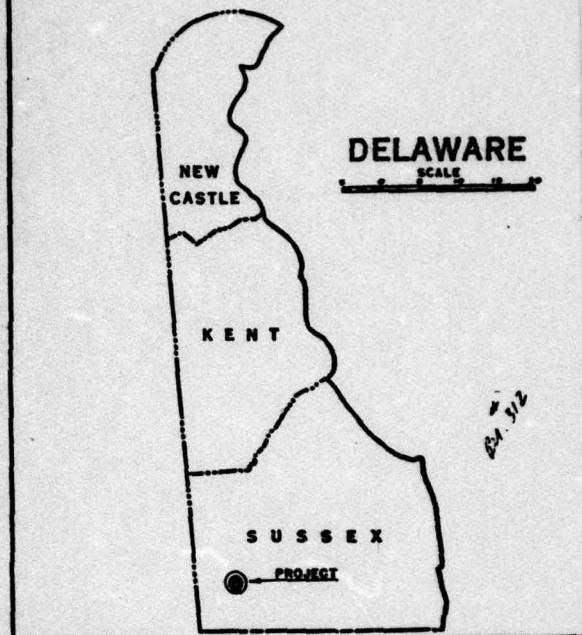
PROJECT N°



TO DIRECTOR

COUNTY	CONTRACT	DATE	STATE	FEET TO F.O.D.	FISCAL YEAR	BLDG. N.
SUSSEX	1459	2	DEL			

HORSEYS POND DAM



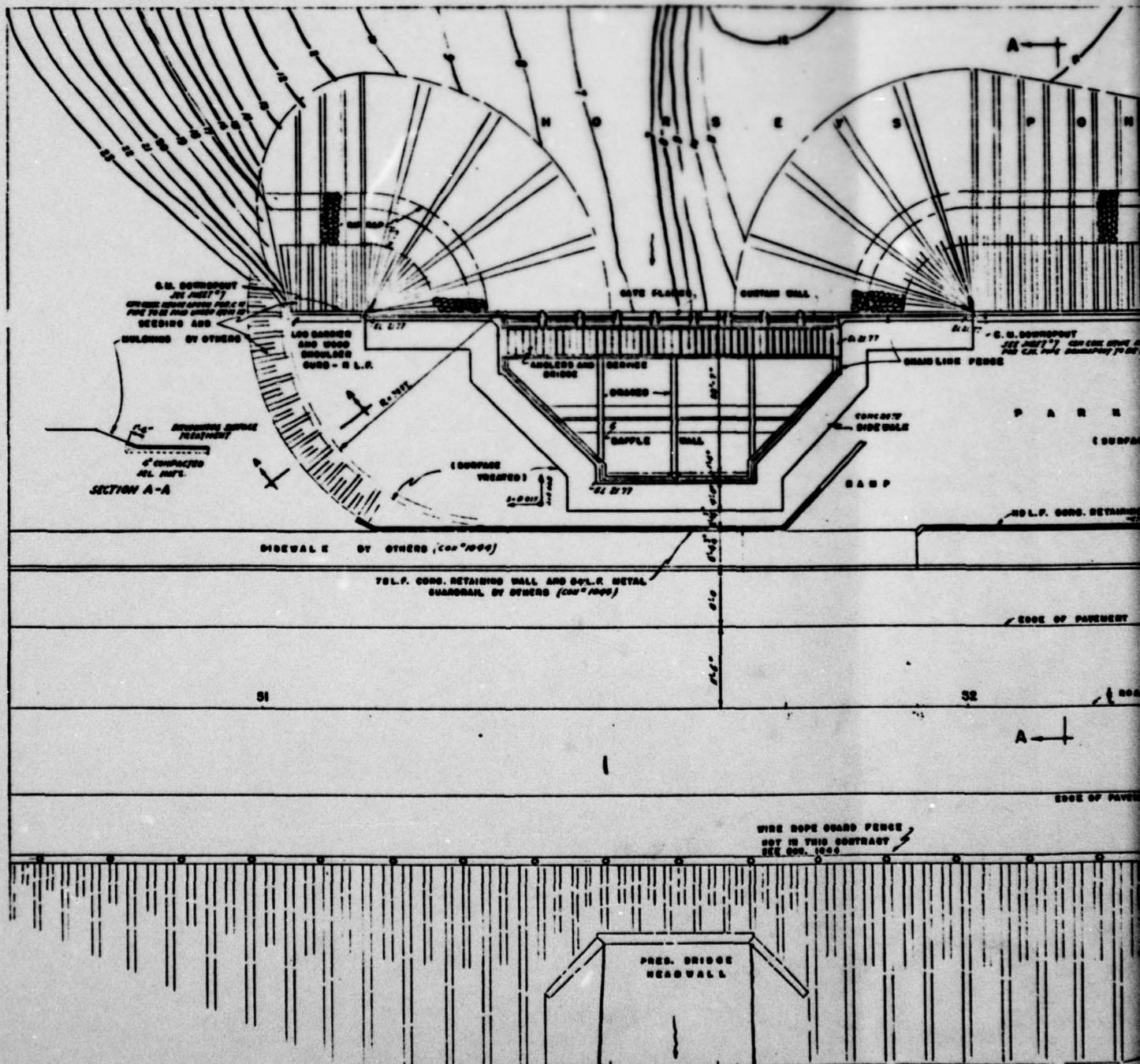
BOOK NUMBER LOOSE LEAF

BA-312

PLATE 2

RECOMMENDED 5/8 1956 *Joe S. Relinow* ENGINEER
 RECOMMENDED 5-11 1956 *L.W. Rosengren* CONSTRUCTION SUPERVISOR
 APPROVED 5-11 1956 *J.W. Weber* CHIEF ENGINEER

APPROVED
CHIEF ENGINEER
DATE



COUNTY	CONTRACT	DATE	STATE	PER. NO. PROJECT NO.	POLAR. YARD	SHED. NO.	TOTAL SHEETS
SUSSEX	1459		DEL.			2	7

HORSEYS POND DAM

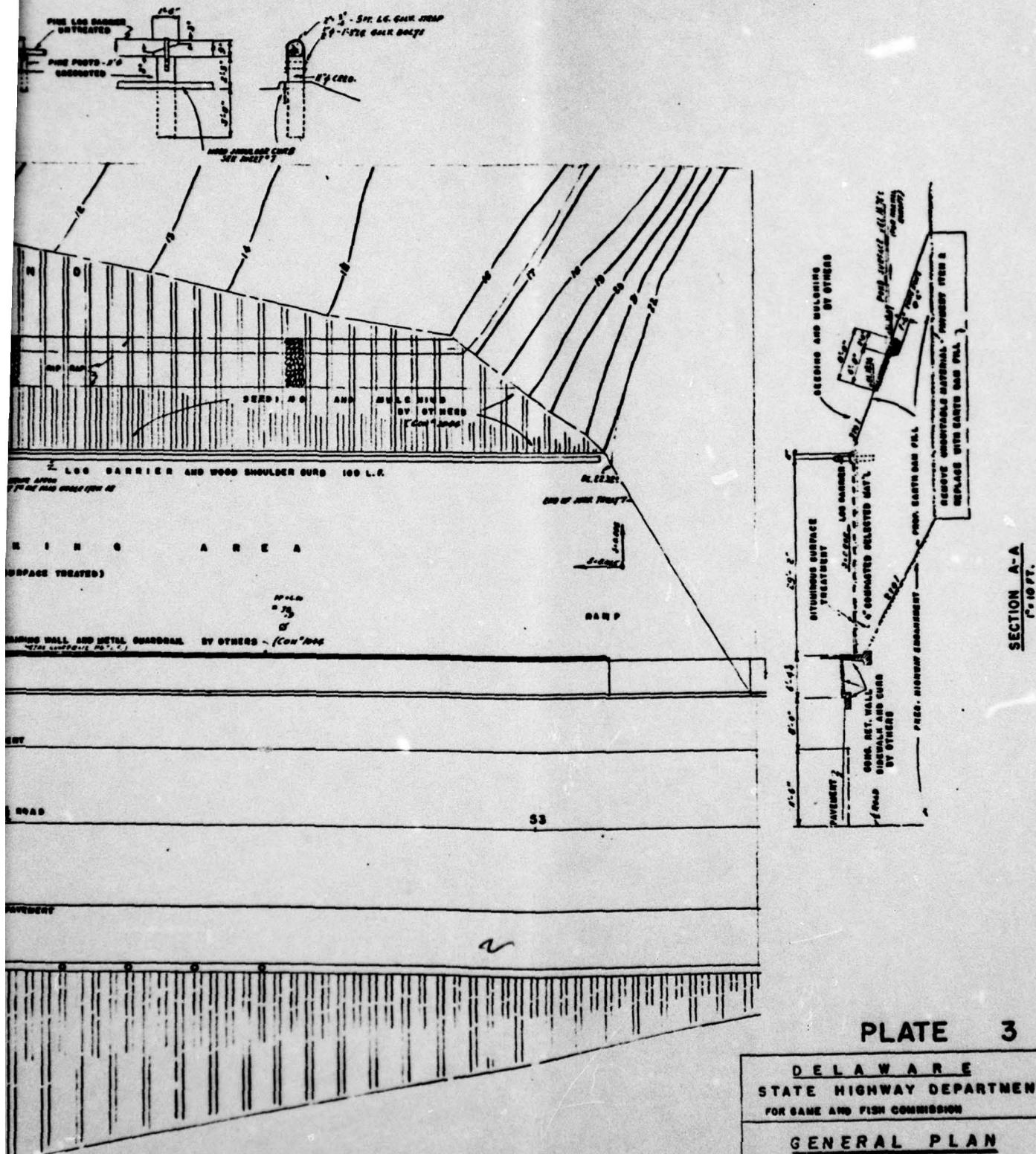


PLATE 3

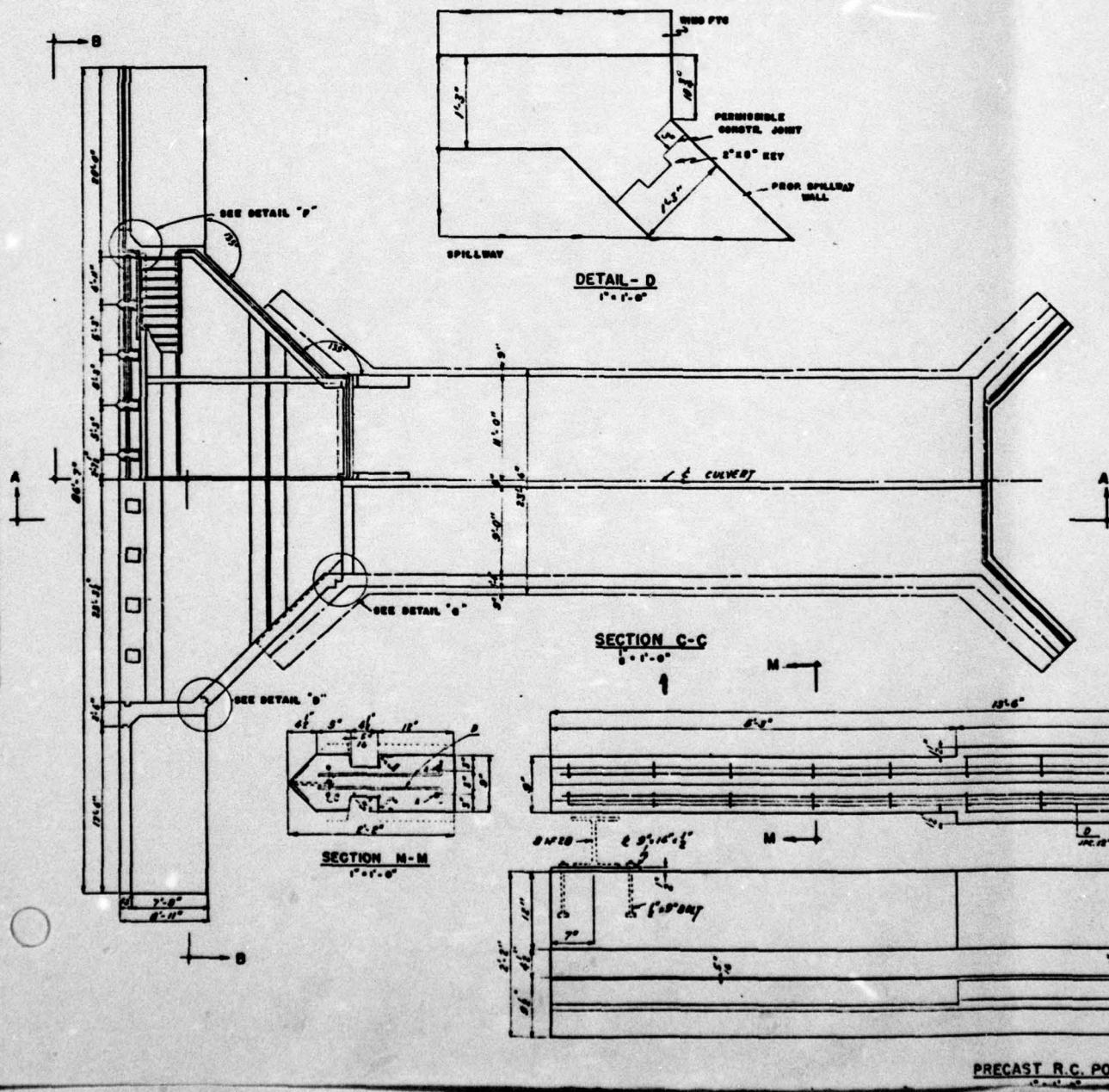
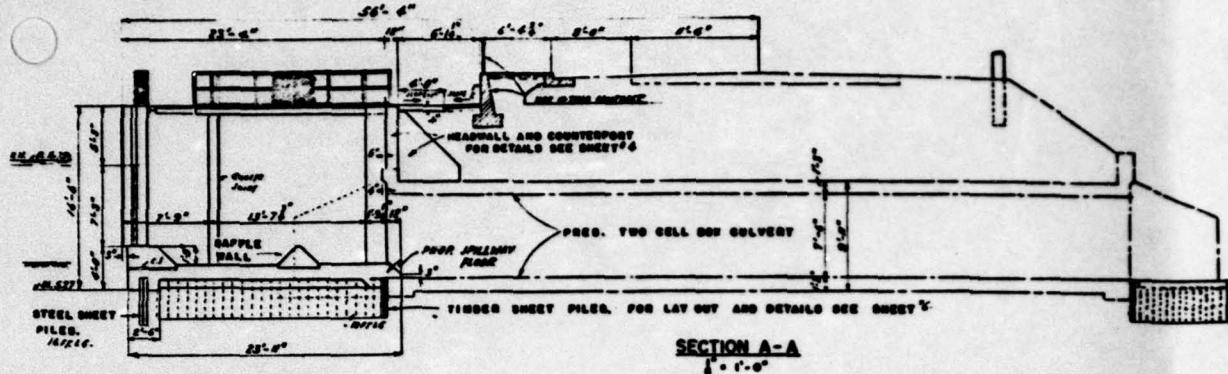
DELAWARE
STATE HIGHWAY DEPARTMENT
FOR GAME AND FISH COMMISSION

GENERAL PLAN

DRAWN BY: J. E. KELLY
TRACED BY: J. C. C.
CHECKED BY:

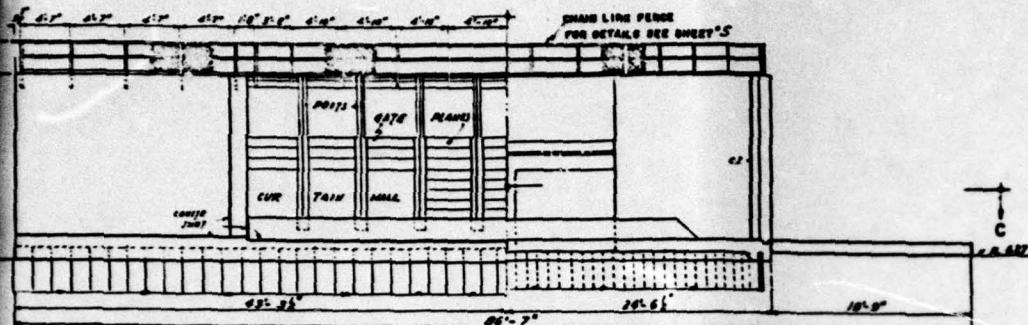
SCALE
1" = 10 FT.

APPROVED BY:
J. S. KELLY
BRIDGE ENGR.

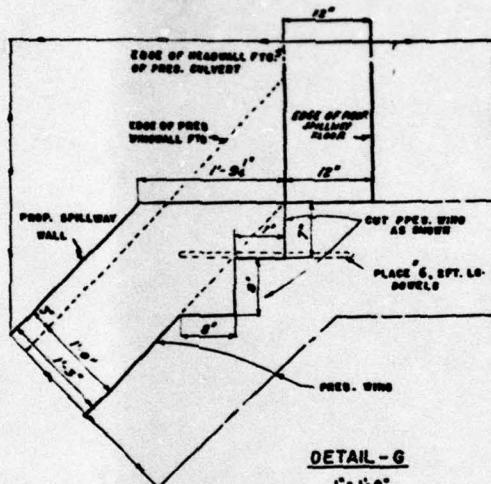


COUNTY	CONTRACT	F.O.A. NO.	STATE	FED AID PROJECT NO.	FEDERAL AID AMT	STATE AID AMT	Total Aid
SUSSEX	1459	2	DEL			3	3

HORSEYS POND DAM

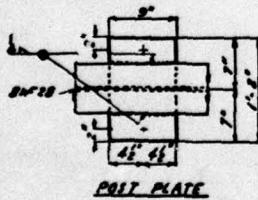


SECTION B-B



DETAIL - G

DETAIL - F



REINFORCING STEEL FOR POST						BENDING DETAIL	
STRAIGHT BARS			BENT BARS				
NO.	NO.	JISCE LENGTH	NO.	NO.	JISCE LENGTH		
A	2	" 8 18.0"	D	26	" 6 11.0"		
B	2	" 4 7.9"					
C	3	" 4 10.0"					

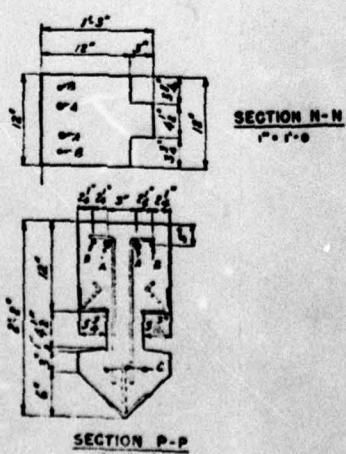
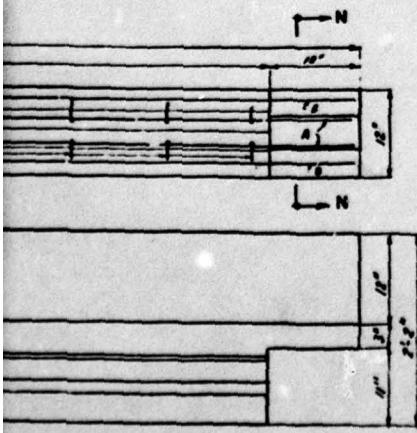


PLATE 4

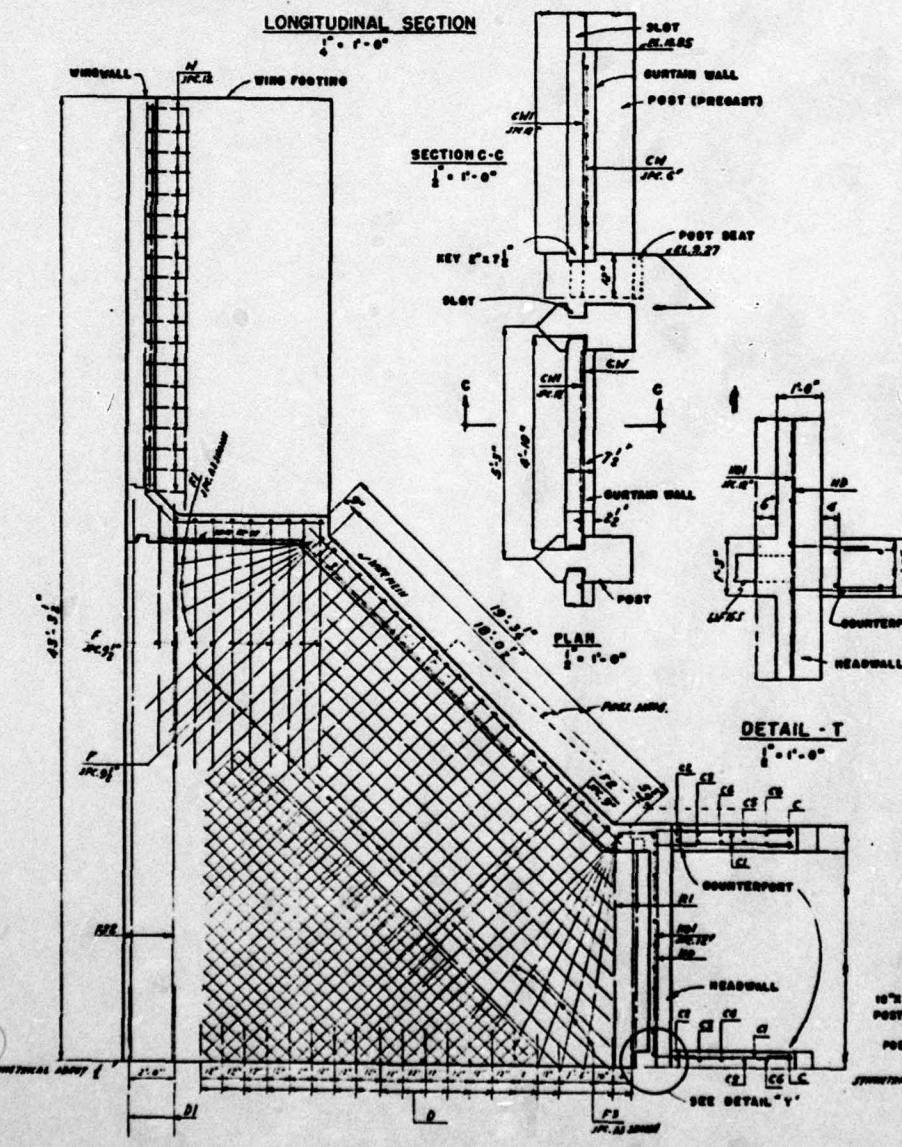
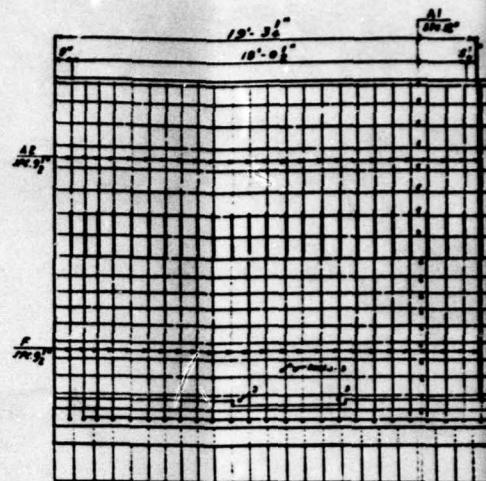
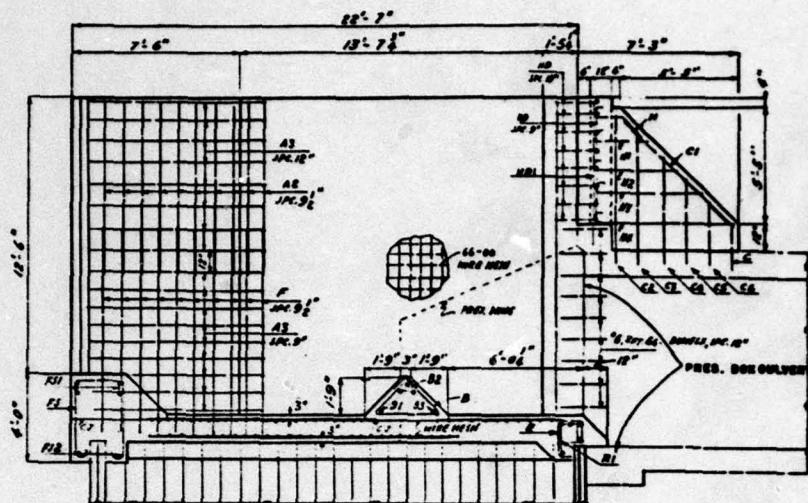
**DELAWARE
STATE HIGHWAY DEPARTMENT
FOR GAME AND FISH COMMISSION**

LAY OUT AND MASONRY DETAILS

SEARCHED BY E.E.R.
INDEXED BY S.M.S.
TRACED BY A.J.P.
CHECKED BY J.H.C.
5/2/56

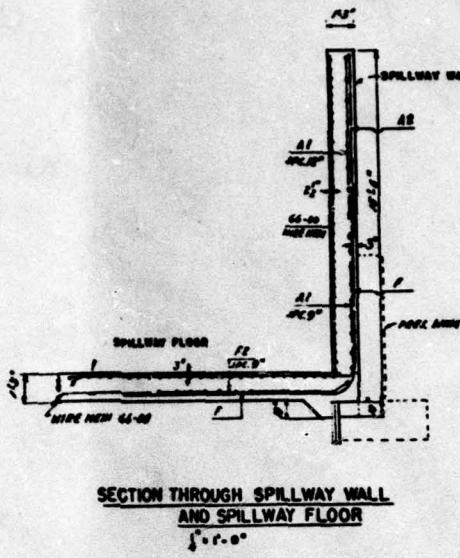
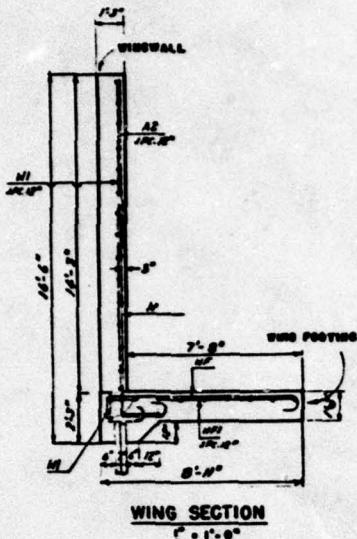
卷之三

APPROVED BY
Jac S. Kalman
BRIDGE ENGINEER



COUNTY	CONTRACT	P. O. NO.	STATE	FED. AID PROJECT NO.	FISCAL YEAR	BUDGET NO.	TOTAL BUDGET
SUSSEX	1454	2	DEL.			4	7

HORSEYS POND DAM



LOCATION	STRAIGHT BARS	BENT BARS
	NO. SIZE LENGTH IN.	NO. SIZE LENGTH IN.
SPILLWAY FLOOR (INSIDE)	10 "6" 8'-0" #11	70 "8" 10'-0" #12
" "	26 "8" 10'-0" #2	70 "8" 10'-0" #2
" "	12 "8" 10'-0" #2	
" "	66-30 Holes 100% #11	
" (TOP) 66-00 Holes 100% #11		
" TONGUE (OUT)	68 "6" 3'-0" BONNELL -0	
FRONT JAMB (BOT) 100% #11	4 "6" 22'-6" #12	27 "6" 10'-0" #5
" " TOP	8 "8" 23'-0" #11	
" BONNELL (TOP & BOTTOM)	6 "8" 7'-0" #2	
" BONNELL (NO BONNELL)	8 "8" 5'-0" #2	
BAFFLE WALL	2 "6" 11'-6" #1	15 "6" 6'-6" #2
" "	6 "6" 15'-6" #2	
" "	2 "6" 10'-6" #3	
" BONNELL	10 "6" 3'-0" #2	
REAR JAMB	10 "6" 10'-0" #2	10 "6" 6'-6" #2
SPILLWAY WALL	34 "6" 10'-0" #11	34 "8" 10'-0" #12
" "	70 "6" 8'-0" #2	70 "8" 8'-0" #2
" "	66-00 100% Holes #11	
" "	10 "6" 2'-0" BONNELL #11	
ENDERWALL FOOTINGS	16 "6" 10'-6" #11	66 "8" 10'-0" #12
" "	8 "6" 17'-0" #11	
" BONNELL	24 "6" 3'-0" #2	
ENDERWALLS	30 "6" 17'-0" #11	10 "6" 11'-0" #2
" "	38 "6" 6'-6" #2	
COUNTERPORTS	6 "6" 6'-0" C1	6 "6" 3'-6" #2
" "	6 "6" 6'-0" C2	6 "6" 3'-6" #2
" "	6 "6" 6'-0" C3	6 "6" 4'-0" #2
" "	6 "6" 6'-0" C4	6 "6" 3'-6" #2
" "	6 "6" 6'-0" C5	6 "6" 3'-6" #2
" "	6 "6" 3'-0" C6	6 "6" 3'-6" #2
HEADWALL	22 "6" 6'-6" #11	8 "6" 22'-0" #2
CURTAIN WALLS	30 "6" 6'-6" #11	34 "6" 5'-6" #2

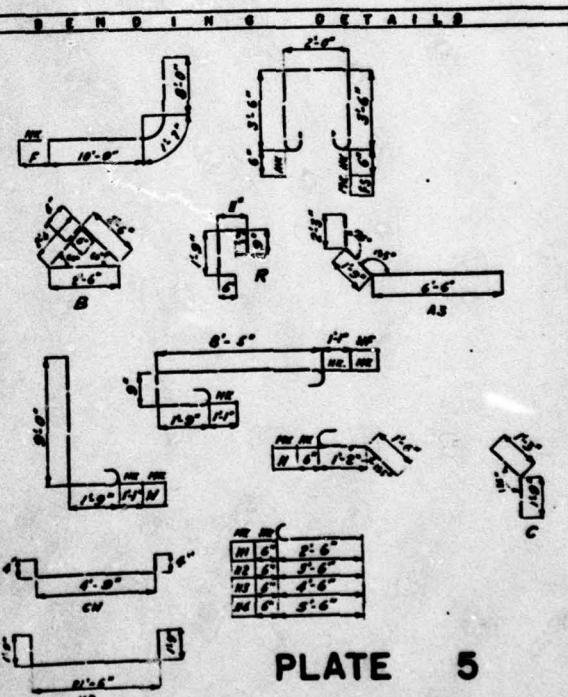
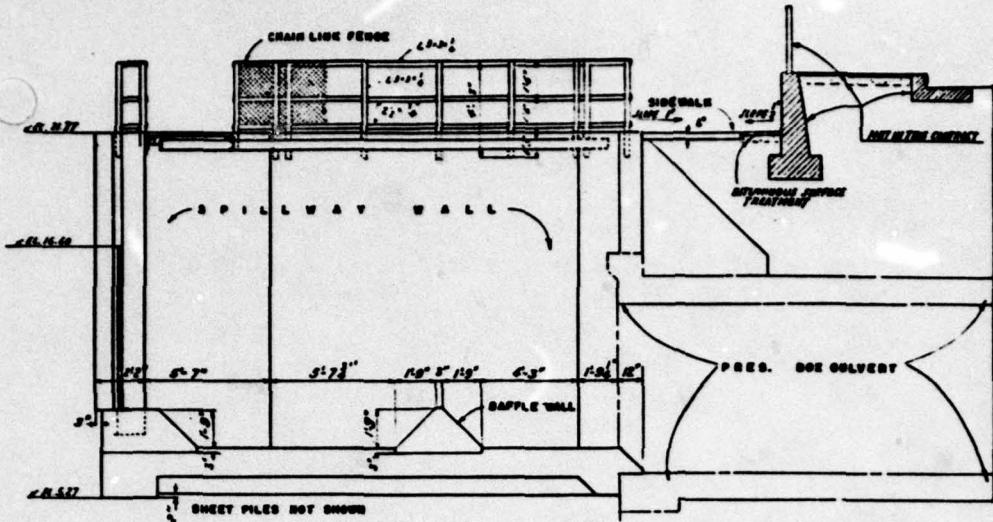


PLATE 5

DELAWARE
STATE HIGHWAY DEPARTMENT
FOR GAME AND FISH COMMISSION

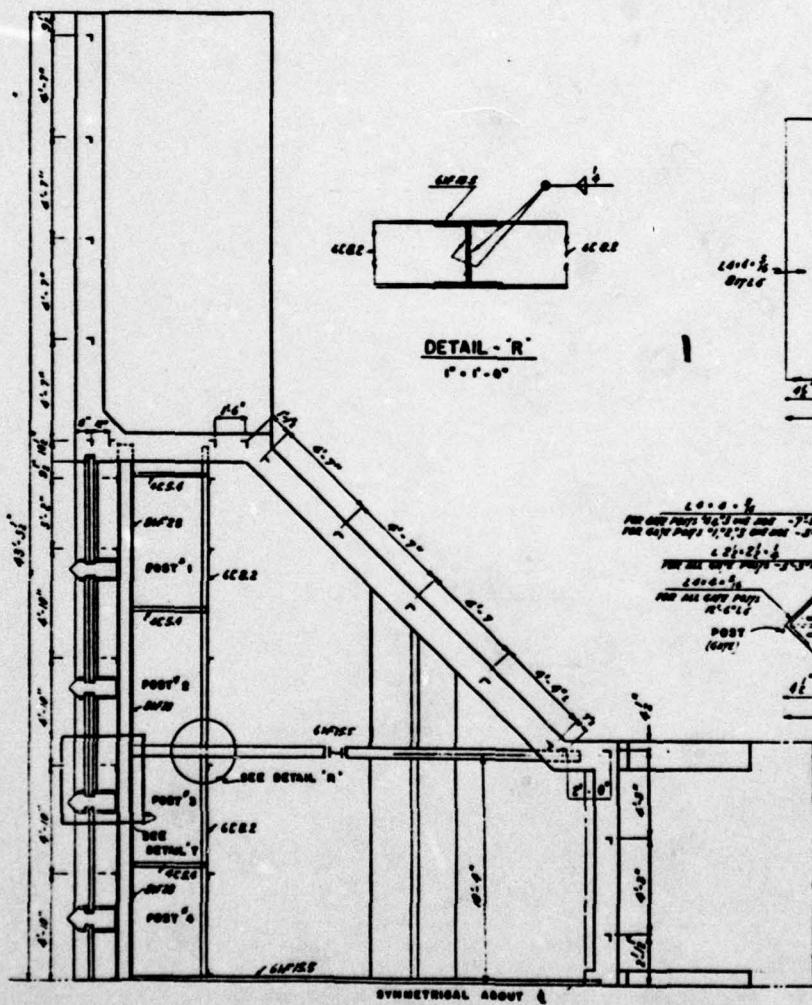
LAYOUT OF REINFORCING STEEL

DRAWN BY <i>[Signature]</i> TRACED BY <i>[Signature]</i> CHECKED BY <i>[Signature]</i> 5/7/56	SCALE AS SHOWN	APPROVED BY <i>[Signature]</i> John S. Palmer BRIDGE ENGR.
--	----------------	---



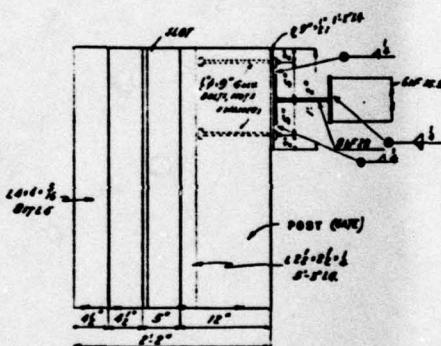
LONGITUDINAL SECTION.

1' = 1'-0"



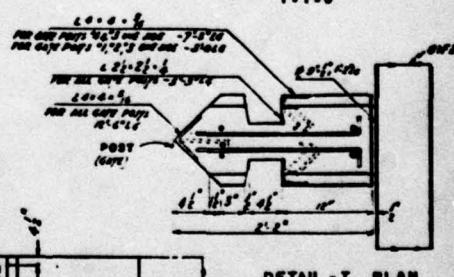
HALF PLAN

1' = 1'-0"



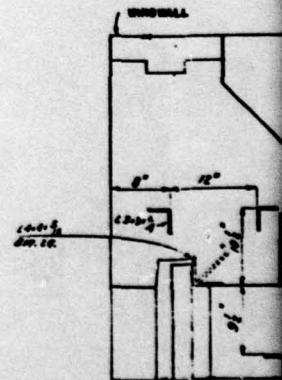
DETAIL 'T', ELEVATION

1' = 1'-0"



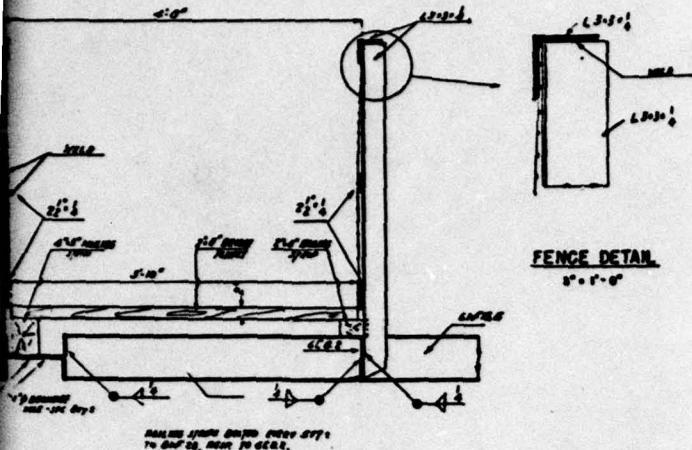
DETAIL 'T', PLAN

1' = 1'-0"



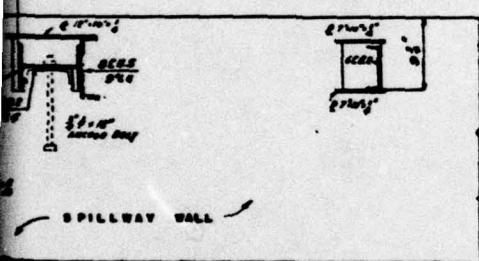
COUNTY	CONTRACT	O. O. I.	STATE	PED. AND PROPERTY NO.	PERIOD	NUMBER	AMOUNT
SUSSEX	1438	2	DEL.			8	7

HORSEYS POND DAM



SERVICE AND ANGLERS BRIDGE SECTION

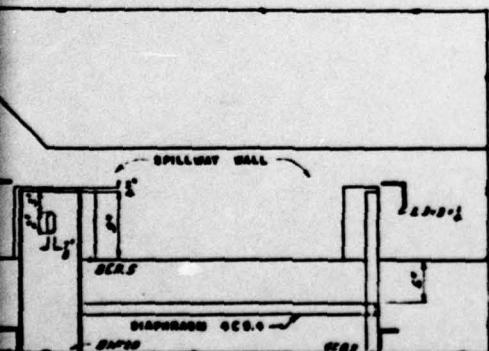
P-10



SERVICE BRIDGE BEARING SEATS

ELEVATION

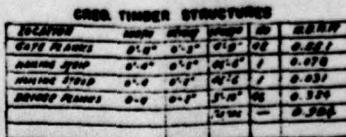
F. F. G.



SERVICE ENGINE BEARING SEAT

PLAN

5-5-9



CANAL TUMOUR STRUCTURES

LOCATION	MIN	MAX	Avg	#	GRAN
GATE PLAYERS	0.0"	0.3"	0.0"	08	0.001
ARMING GROUP	0.0"	0.1"	00.0"	1	0.001
MUNIC. STORE	0.0"	0.3"	00.0"	1	0.001
DRIVING PLAYERS	0.0	0.4"	0.10"	08	0.006
			0.000		0.000

PLATE 6

DELAWARE
STATE HIGHWAY DEPARTMENT
FOR GAME AND FISH COMMISSION

STRUCTURAL STEEL

AND
CREO. TIMBER STRUCTURES

DRAWN BY E. S. Tolson
CHECKED BY E. S. Tolson
APPROVED BY H. S. Tolson
BRIDGE ENGINEER

GENERAL NOTES

THIS STRUCTURE IS LOCATED IN SULLIVAN COUNTY
ON MEADOW BRANCH AT ROAD #24 (SEE TYPE SHEET PILE).

TYPE OF DELAWARE STATE HIGHWAY DEPARTMENT
STANDARD SPECIFICATIONS DATED JANUARY 1, 1956.

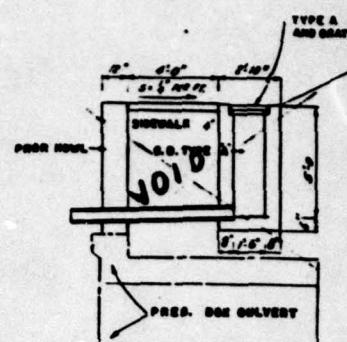
SUPERFICIAL WATERPROOFING TO BE APPLIED TO THE
VERTICAL SURFACES OF WINGS AND SPILLWAY
WALLS IN CONTACT WITH EARTH BACKFILL.

TIMBER FOR GATE PLANKS AND BRIDGE FLOORING
SHALL BE CROWDED, ALL STRUCTURAL STEEL AND
HARDWARE SHALL BE GALVANIZED.

FOR THE CONSTRUCTION METHODS OF EARTH DAM
AND CONTROL STRUCTURE REFER TO SPECIAL
PROVISIONS.

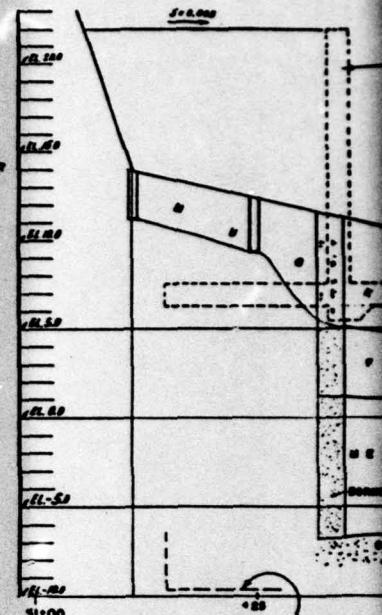
DRAINAGE AREA - 9200 ACRE. AC 10.63.41.

QMAX = 900 CFS.

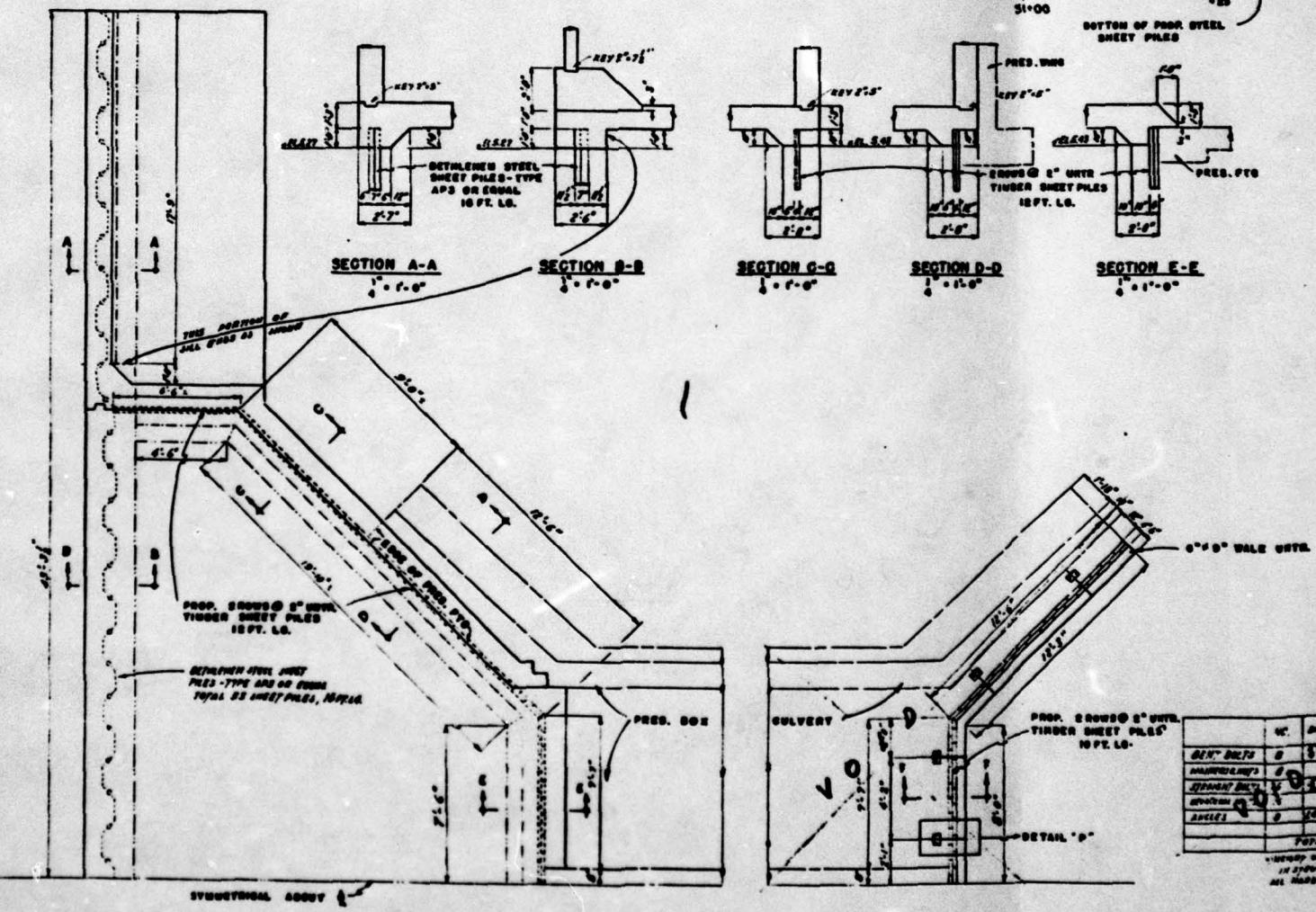


SECTION THROUGH C.E.

1'-0"



BOTTOM OF PRES. STEEL
SHEET PILES



ITEM	QUANTITY
8" BELTS	6
MANIFOLDING	6
STUDS	6
GRATING	6
ANGLES	6
TOTAL	33

NOTE: WEIGHT OF SHEET PILES IN STANDING POSITION
NOT INCLUDED

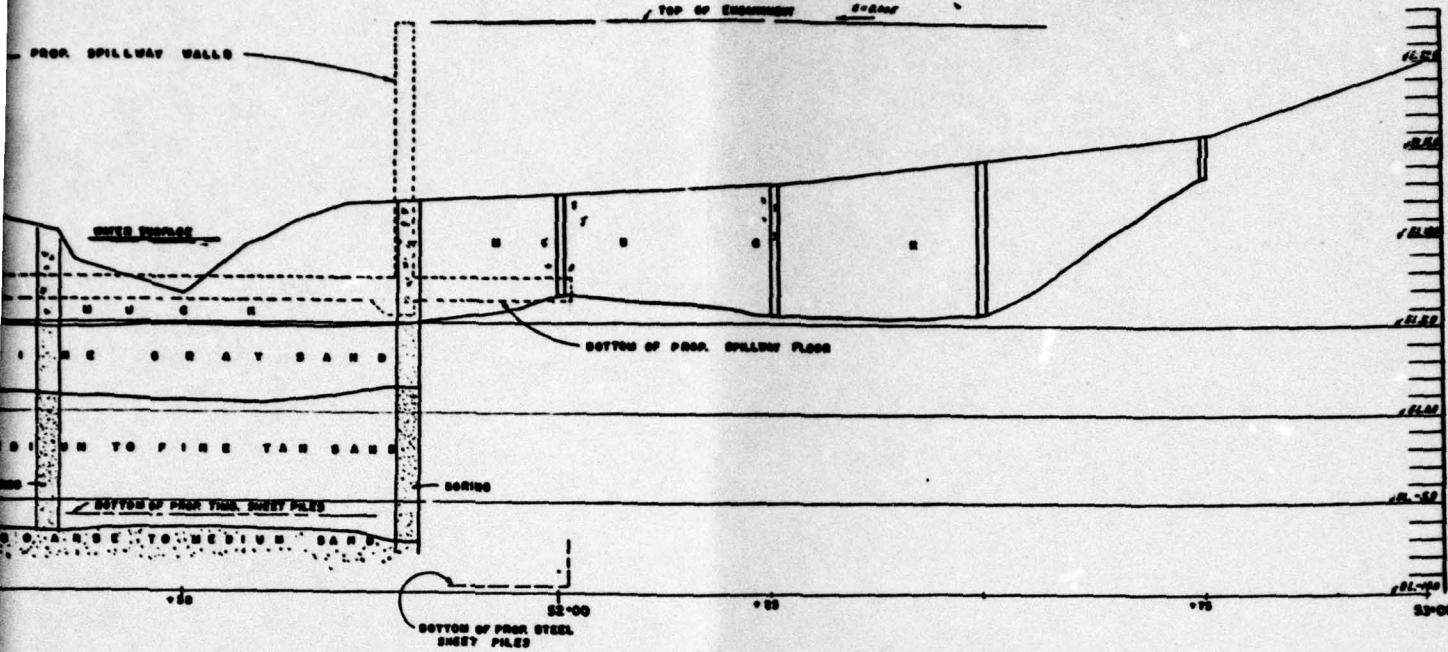
SHEET PILING PLAN

1'-0"

DEPTH OF HUCK - 47° L. OF 1 ROAD
470. 52-15
470. 52-00
470. 52-25
470. 52-50
470. 52-75

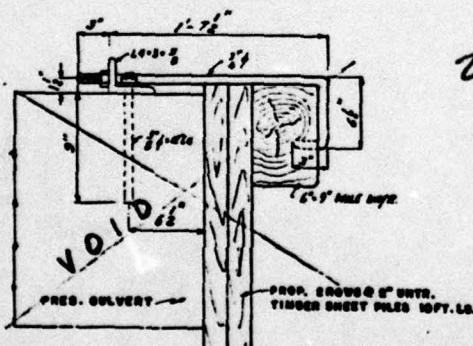
COUNTY	CONTRACT	P.O. NO. CITY, STATE	STATE	PROD. AND PROCESSING CO.	P.O. MAIL HEAD	SHIP- TO	COM- MENT
SUSSEX	1459	3 DEL.				6	7

HORSEYS POND DAM



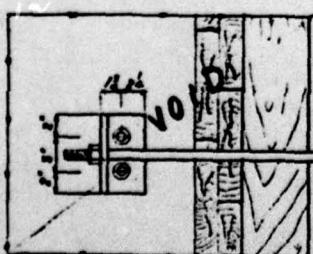
SECTION 54' L OF C ROAD (SEE SHEET # 2)

V = 1' = 5'-0"
H - 1' = 10'-0"



SECTION F-F

18 • 19 • 86



PLAN - DETAIL "P"

QUANTITIES				
ITEM	DESCRIPTION	UNIT	TOTAL QUAN.	PRICER
2	EXCAVATION	C.Y.	1500	1600
4	EXCAVATION FOR STRUCTURES	C.Y.	221	250
7	SELECTED BORROW	C.Y.	3500	4000
17	CREO. TIMBER STRUCTURES	M.F.T.B.M.	0.904	1,100
18	CEMENT CONC. MASONRY	C.Y.	1625	1700
19	SUPERFICIAL WATERPROOFING	SQ.Y.	215	220
20	BAR REINFORCEMENT (INCL. WIRE BEAD)	LBS.	16700	15.00
22	STRUCTURAL STEEL (INCL. CHAIN LINK FENCE)	LBS.	7922	10.00
33	TIMBER SHEET PILES (UNTREATED):	M.F.T.B.M.	3.400	4,000
	R I P R A P	SQ.Y.	200	220
	STEEL SHEET PILES	LBS.	10675	20.00
	MISCELLANEOUS ITEMS	L.S.	L.S.	
BITUMINOUS SURFACE TREATMENT SEE APPROX. QUANTITIES LISTED BELOW.				

APPROX. QUANTITIES FOR L.S. ITEMS				
ITEM# 200 ITEMS	WOOD SHOULDER CURB AND LOG BARRIER 120 L.E. CONG.			
	SHOWALK APPROX. 52 SQ.Y. CORR. METAL PIPE 24 L.F.			
	ASPHALT	SLAB CHIPS	CRUSHED STONE	SEL. DIRT/GR.
	NO-1	NO-2	OR GRAVEL	
	500 BBL. 10000 LBS.	N. E. TON	11.2 TON	63 C.U. YD

2 APPROPRIATE QUANTITY FOR SURFACE TREATMENT 500 ml.

PLATE 7

DELAWARE
STATE HIGHWAY DEPARTMENT

SHEET PILING PLAN
AND BORINGS

DRAWN BY #38
6/6/56
TRACED BY 472
CHECKED BY C.A.
5-1

APPROVED
Joe S. Robins
BRIDGE ENGINEER

Sta. 50-85 to Sta. 52-75, R.
Build 950' Wire Rope Guard Fence,
~~**500' Wood Stake Curb, 50' S.M. Damper,**~~
~~**& End Post Attachments.**~~
R.

CONSTRUCT AN EXISTING CULVERT

PLACE 33418 - R.G.P.
BUILD 1 - TYPE 40° G.C.

CHARLES MARVEL

CARLTON J. SPICER

HOWARD H.

DEANAGE QUANTITIES STATION TO STA 56-142
ARE GIVEN ON SHEET -7-

SEWELL F. HEARN

Remove Headwalls
Extend 18" R.C. Pipe
Right & Left
21' 21'

ROBERT S BROCK

BUILD 1-TYPE "J" G.P.

BUILD 1-TYPE "T" C.B.

BM = 9 Nails in S Plan
2710 Sq Ft 60 x 179
Elevation 2733

HOWARD H. DICKERSON

PLAT RECORDED 5/26/56
BOOK #2

LOUISE BARR

HOWARD H. DICKERSON

PLOT RECORDED 5/24/56
BOOK #2

LOUISE BARR

DITIONS TO
ART. SEE SHEET #2:

COUNTY	CONTRACT	P.P. S.Y. NO.	STAGE	PUB. AND PROJECT NO.	P.P. YEAR	SHOOT NO.
SUSSEX	1094	8	REL	F 31(2)	8	

LAUREL TO SHARPTOWN

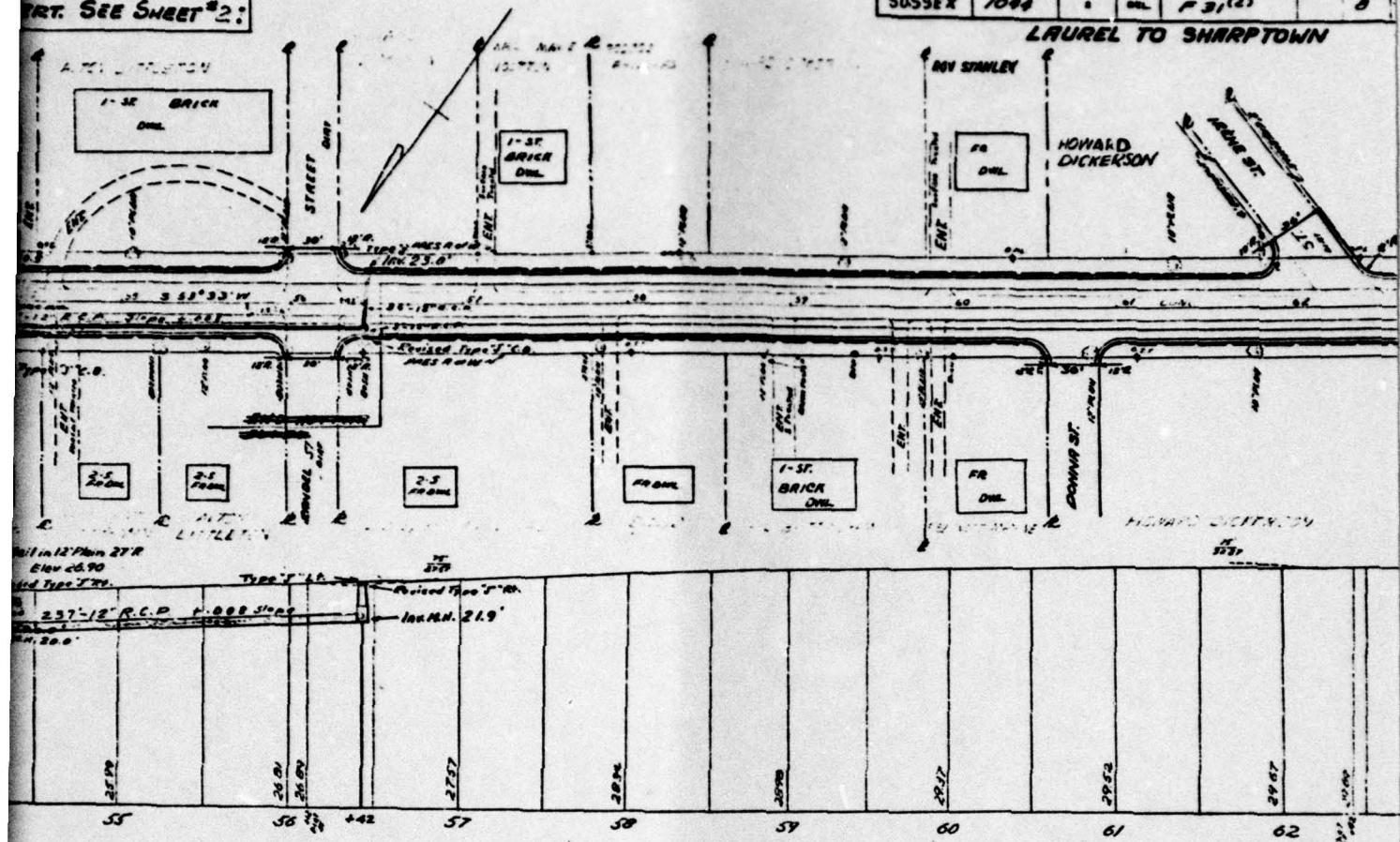
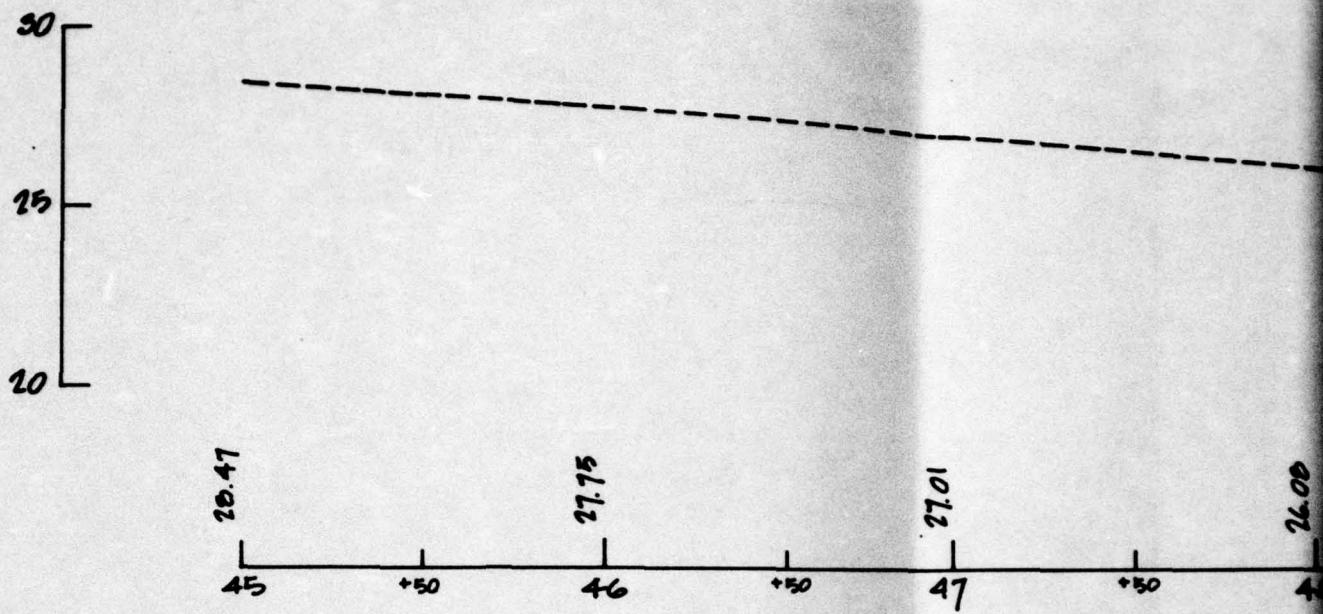


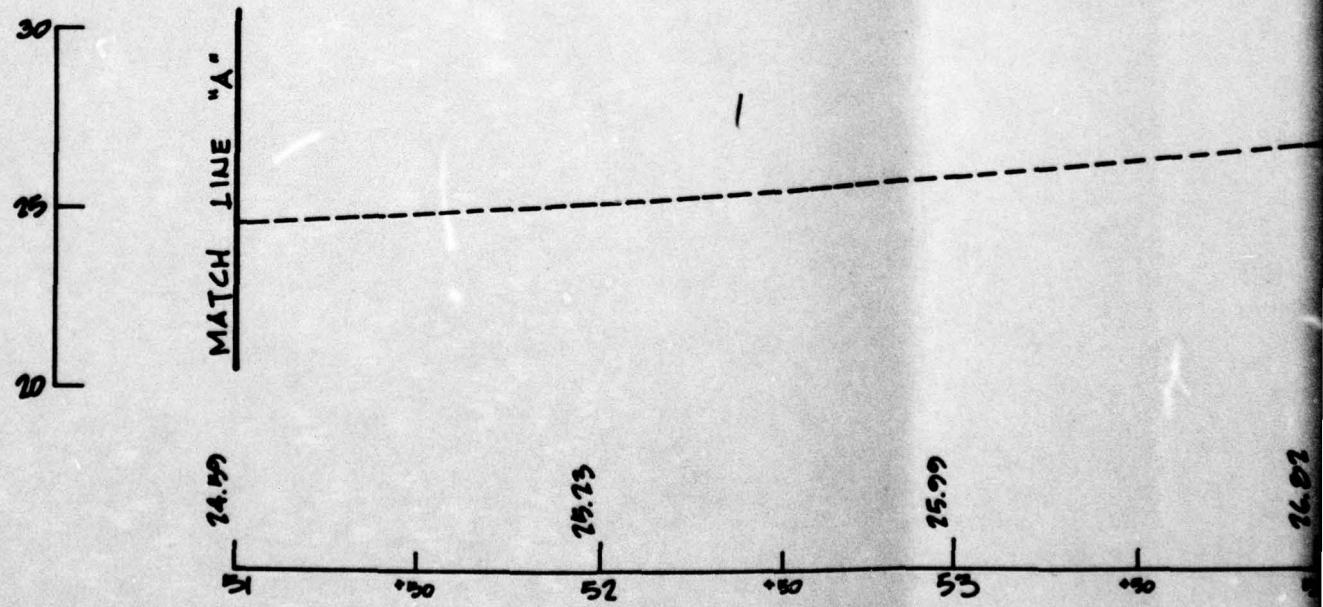
PLATE 8

B.M. #10 New in 12 Plate 26A
Sku 74-000 Eku 311B

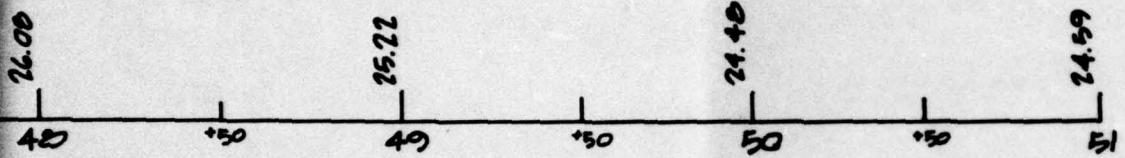
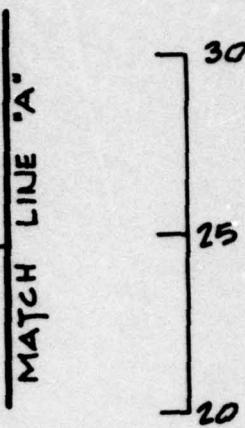


**E PROFILE RT. 24
(HORSEY'S POND)**

SCALE: HORIZ 1" = 50'
VERT 1" = 5'



ft or HORSEY'S DAM
BRIDGE



FIELD SURVEY INFORMATION

BY
MOORE - LIPPINCOTT ENGINEERS
DECEMBER 1978

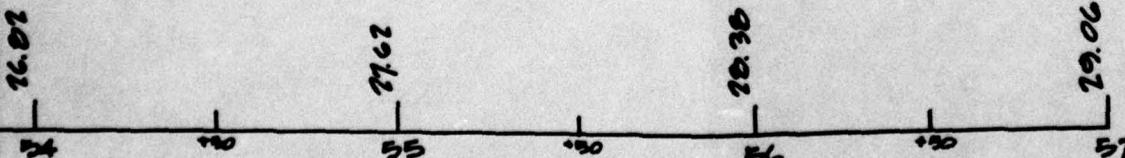
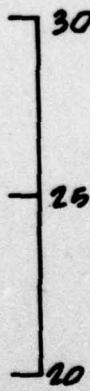
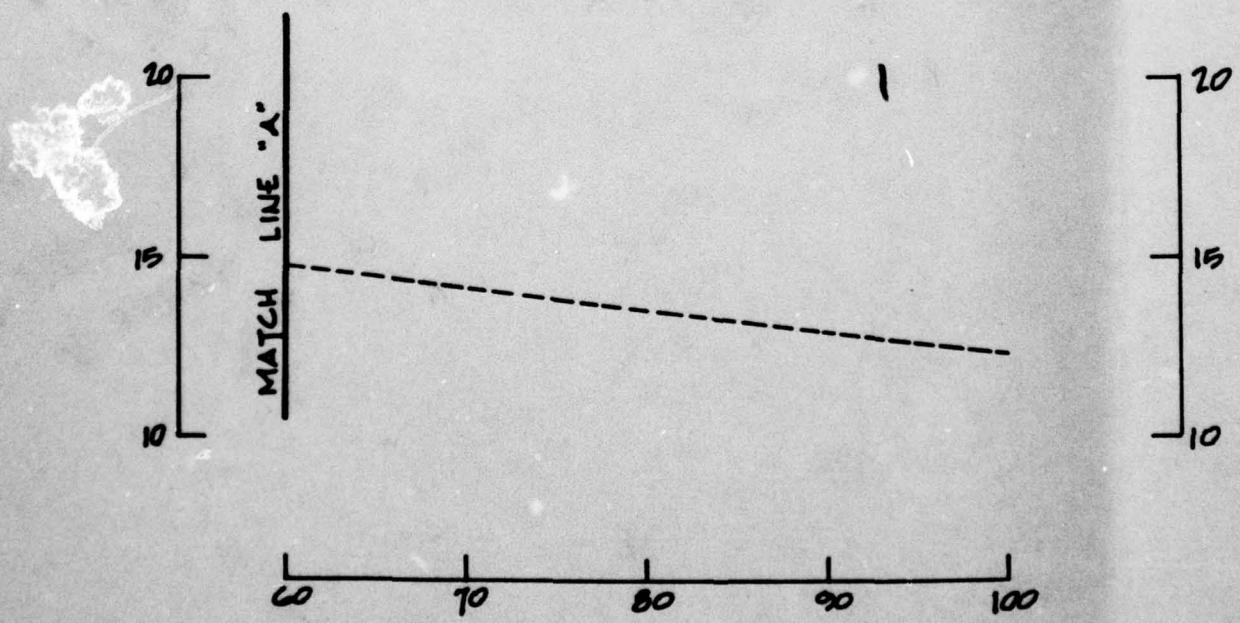
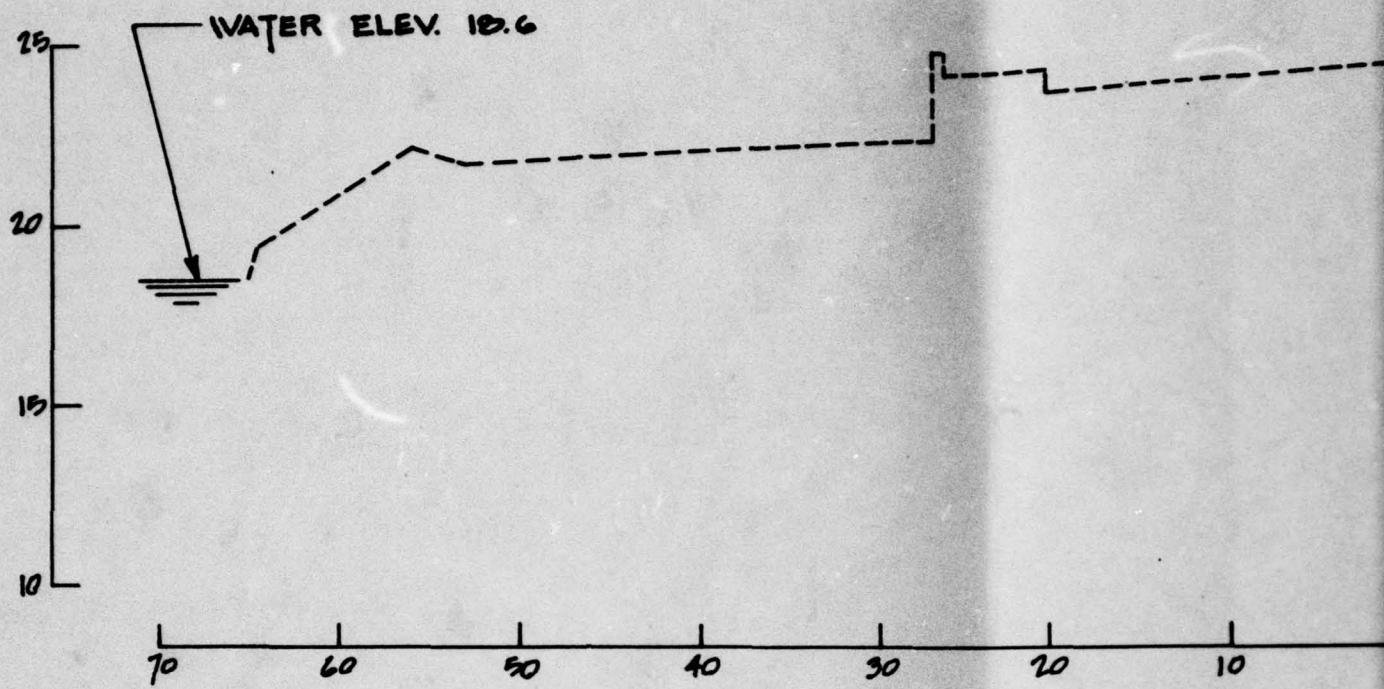
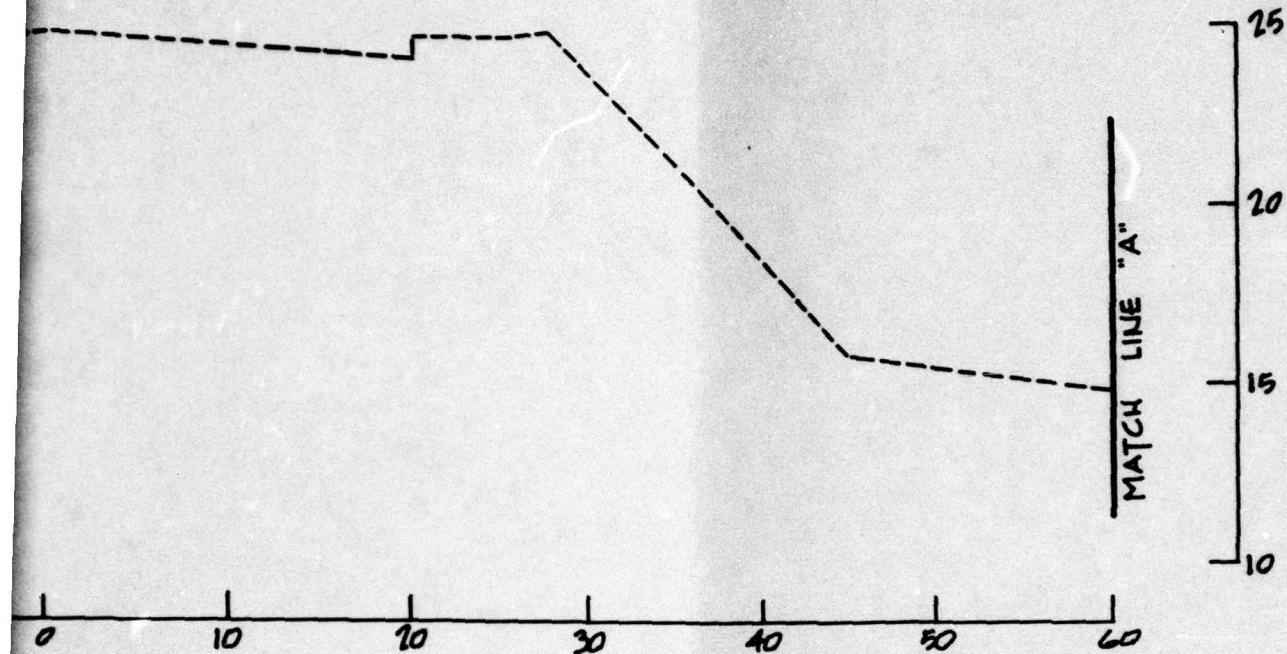


PLATE 9





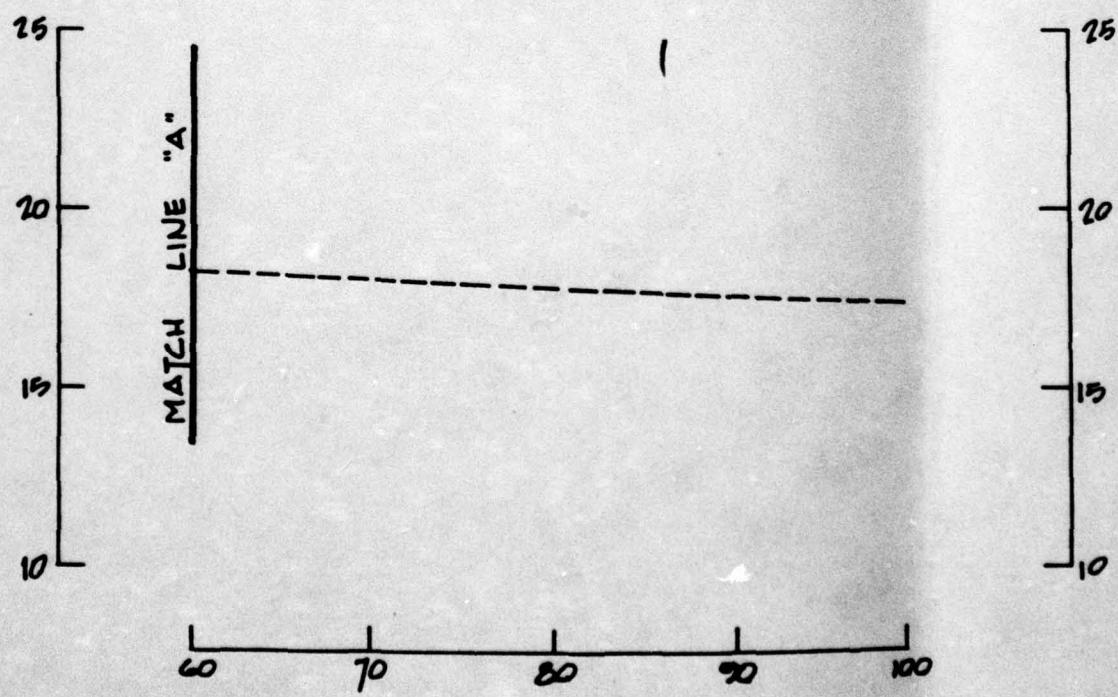
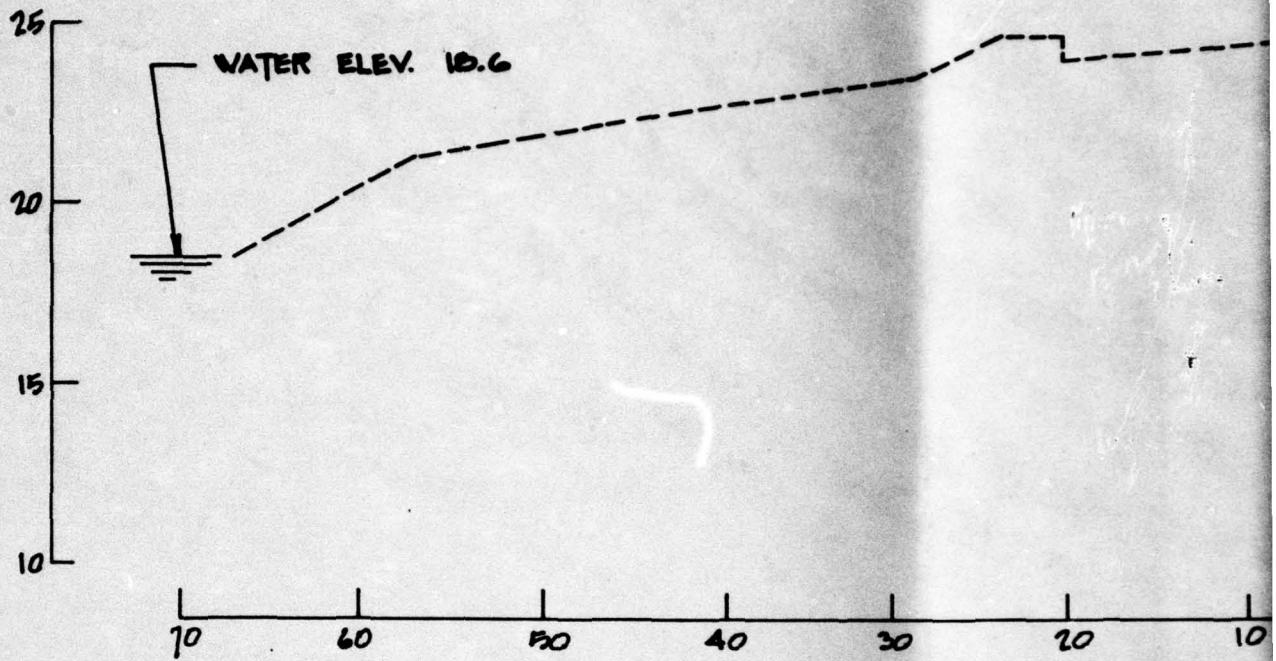
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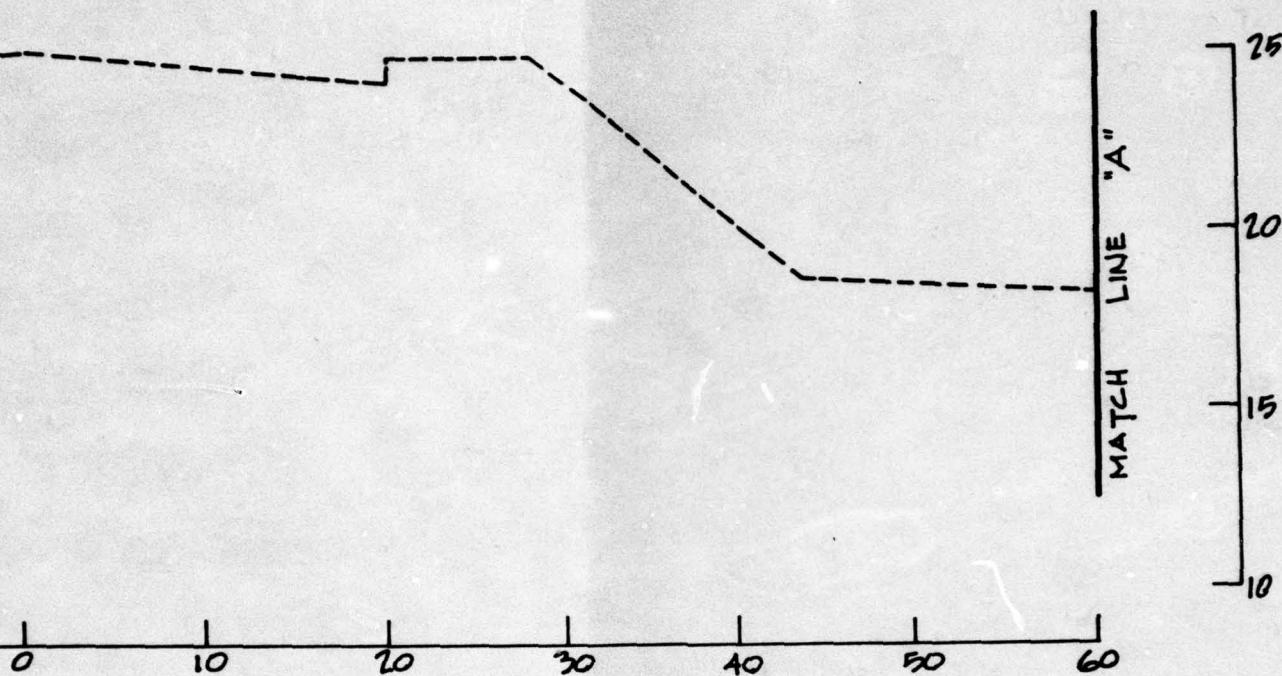
CROSS-SECTION @
STA. 51+00
HORSEY'S POND

SCALE: HORIZ 1" = 10'
 VERT 1" = 5'

FIELD SURVEY INFORMATION
 BY
 MOORE - LIPPINCOTT ENGINEERS
 DECEMBER 1970

PLATE 10





v

CROSS-SECTION @
STA. 49 + 50
HORSEY'S POND

SCALE: HORIZ. 1" = 10'
VERT. 1" = 5'

FIELD SURVEY INFORMATION
BY
MOORE - LIPPINCOTT ENGINEERS
DECEMBER 1978

PLATE II

ACCORDING TO OUR PHONE CONVERSATION WITH ROBERT R. JORDAN,
STATE GEOLOGIST WITH THE DELAWARE GEOLOGICAL SURVEYS, THE
GEOLOGY OF THE SUSSEX COUNTY AREA HAS NOT BEEN MAPPED FOR
PUBLICATION AS OF THE WRITING OF THIS REPORT.

GEOLOGIC INFORMATION

PLATE 12

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

**CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA**

Check List
Visual Inspection
Phase 1

Lat: 38°32'05"

Coordinates

Long: 75°35'00"

State

County

Sussex

State

County

Sussex

Dam

Horseys Pond

Date(s)

Inspection

12-7-78

Weather

Cloudy

Temperature

50°F

Pool Elevation at Time of Inspection 18.6 M.S.L.

Tailwater at Time of Inspection 7.6 M.S.L.

Inspection Personnel:

Dan Jacobs

Joe Mahan

Joe Mahan Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None Observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLoughing OR Erosion OF EMBANKMENT AND ABUTMENT SLOPES	None Observed	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST		Large patch in roadway at east end of box culvert. Might have been sinkhole caused by seepage on east side. If area requires patching again, study should be initiated and prevent further seepage.
RIPRAP FAILURES	None Observed	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Seepage noted on each side of box culvert through roadway. Barely noticeable on East downstream side and slow trickle on West downstream side.	This seepage should be monitored at least every three months for three years and every six months thereafter.
ANY NOTICEABLE SEEPAGE	Seepage noted - see above.	5
STAFF GAGE AND RECORDER	None Observed	
DRAINS	None Observed	

VISUAL EXAMINATION OF	OUTLET WORKS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRAKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		None Observed	
INTAKE STRUCTURE		No deterioration spalling noted in concrete. Lifting boards of overflow structure in good overall condition.	
OUTLET STRUCTURE		Box culvert bridge relatively new and in good overall condition.	
OUTLET CHANNEL		N/A	
EMERGENCY GATE		N/A	6

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Overflow structure consists of wooden stop logs spanning between concrete piers. Slight deterioration of center concrete pier near water line on upstream side - not appreciable.	
APPROACH CHANNEL	POND	
DISCHARGE CHANNEL	Box Culvert has some trash in it, including large metal drums and logs.	Debris should be removed.
BRIDGE AND PIERS	N/A	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

RESERVOIR

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Low sloping banks - well vegetated.

SEDIMENTATION

None Observed

DOWNTREAM CHANNEL

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Timber bulkheads constructed immediately downstream - fairly new construction and no obstructions noted.	
SLOPES	Relatively low sloping.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home and six people. House approximately 9' above streambed.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Box Culvert recently constructed. State of Delaware Department of Transportation provided plans with roadway elevations on it.	
OBSERVATION WELLS	N/A	
WEIRS	N/A	
PIEZOMETERS	N/A	
OTHER	N/A	11

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available from Delaware State Department of Transportation
REGIONAL VICINITY MAP	" " " "
CONSTRUCTION HISTORY	" " " "
TYPICAL SECTIONS OF DAM	" " " "
HYDROLOGIC/HYDRAULIC DATA	Design calcs not available, but drainage area and design "Q" indicated on design plans.
OUTLETS - PLAN	Available from Delaware State Department of Transportation
- DETAILS	" " " "
- CONSTRAINTS	" " " "
- DISCHARGE RATINGS	Not available
RAINFALL/RESERVOIR RECORDS	Not available

ITEM	REMARKS
MONITORING SYSTEMS	N/A
MODIFICATIONS	N/A
HIGH POOL RECORDS	Unknown.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	N/A
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	N/A
Maintenance Operation Records	N/A

ITEM**REMARKS****DESIGN REPORTS**

Not Available

GEOLOGY REPORTS

Not Available

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SLEEPAGE STUDIES

Not Available

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

Given on construction plans available from Delaware State Department of Transportation

Not Available

POST-CONSTRUCTION SURVEYS OF DAM

N/A

BORROW SOURCES

Unknown

ITEM	REMARKS
SPILLWAY PLAN	Available from Delaware State Department of Transportation
SECTIONS	" " " " "
DETAILS	" " " " "
OPERATING EQUIPMENT PLANS & DETAILS	N/A

APPENDIX B

PHOTOGRAPHS

PHOTOS TAKEN DURING DECEMBER, 1978

DETAILED PHOTOGRAPH DESCRIPTIONS

- Overall View of Dam - View of Upstream Face of Embankment and Box Culvert Spillway Structure, December 8, 1978

PHOTO 1 - View looking upstream at Horseys Pond

PHOTO 2 - View looking downstream at grading and island

PHOTO 3 - View of horizontal struts supporting overflow structure

PHOTO 4 - View looking east of roadway and upstream wingwall

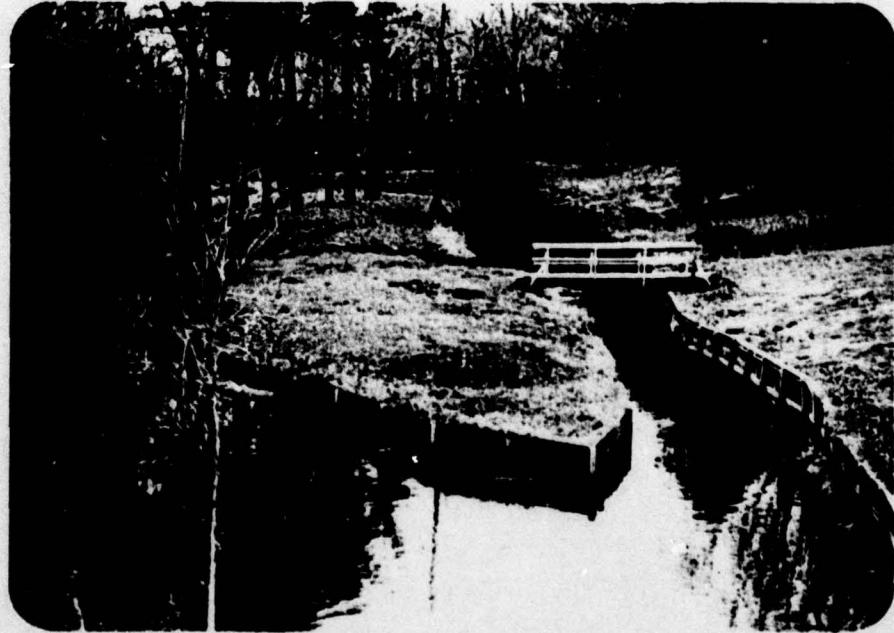
PHOTO 5 - View downstream of overflow structure - downstream of box culvert

PHOTO 6 - View of downstream end of double box culvert

PHOTO 7 - View of house located on downstream embankment



O
PHOTO 1



O
PHOTO 2

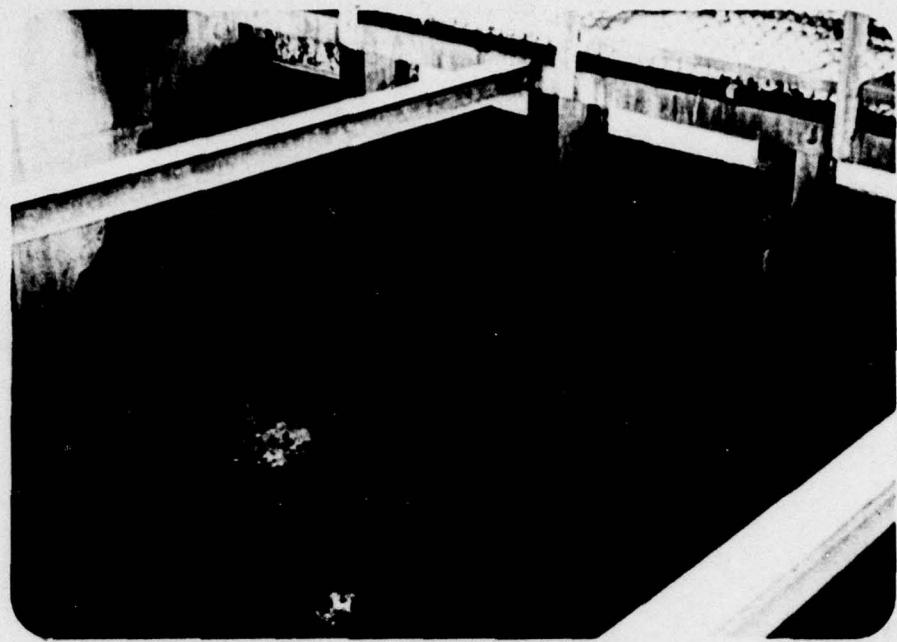


PHOTO 3

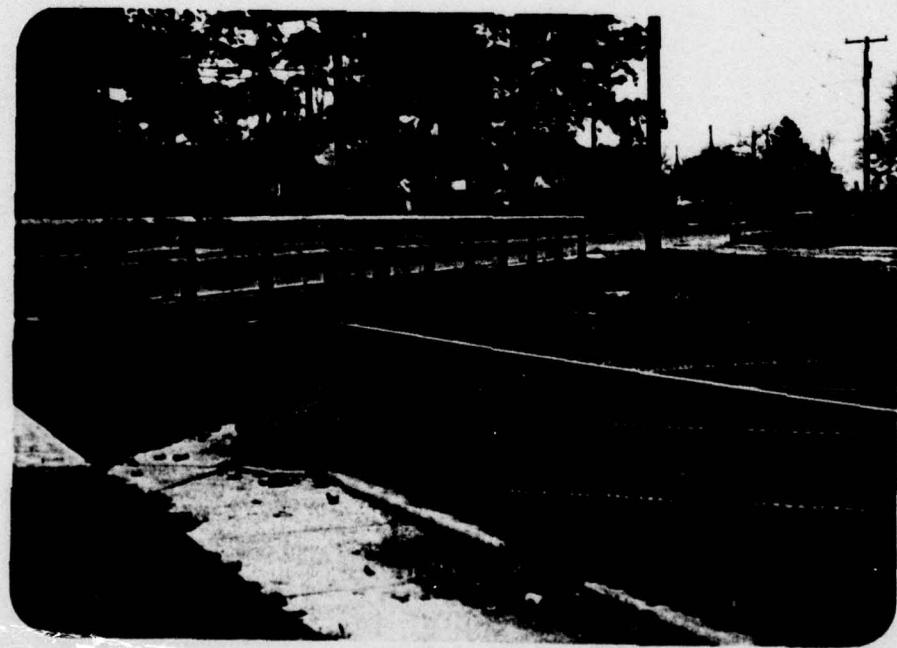


PHOTO 4



PHOTO 5

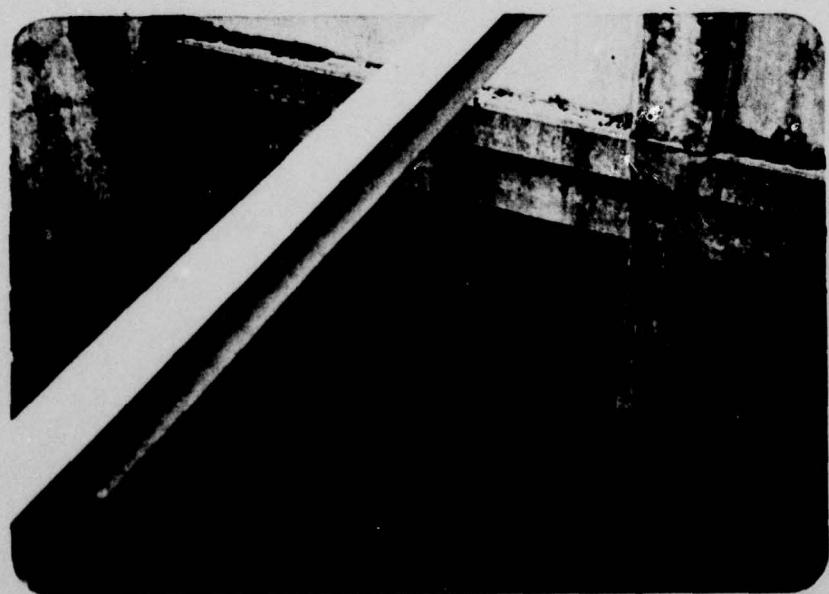


PHOTO 6

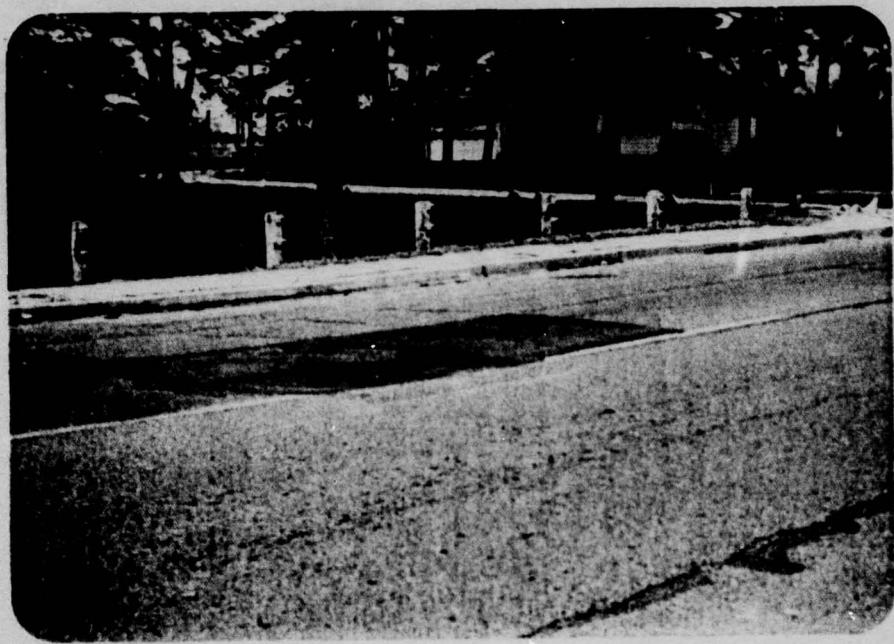


PHOTO 7

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 15.35 Sq. Mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 18.6 ft. M.S.L.(346Ac.Ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 25.6 ft. M.S.L. (1057 Ac.Ft.)

ELEVATION TOP DAM: 24.4 ft. M.S.L. (low point in roadway)

CREST: _____

- a. Elevation 18.4 to 18.8 ft. M.S.L.
- b. Type Wooden stop logs
- c. Width 4"
- d. Length 9 @ 4.5' = 40.5 feet
- e. Location Spillover N/A
- f. Number and Type of Gates N/A

OUTLET WORKS: _____

- a. Type Wooden stop logs Length = 2 @ 4'-6" = 9'-0"
- b. Location Main Spillway
- c. Entrance inverts N/A
- d. Exit inverts 9.2 ft. M.S.L.
- e. Emergency draindown facilities stop logs could be removed

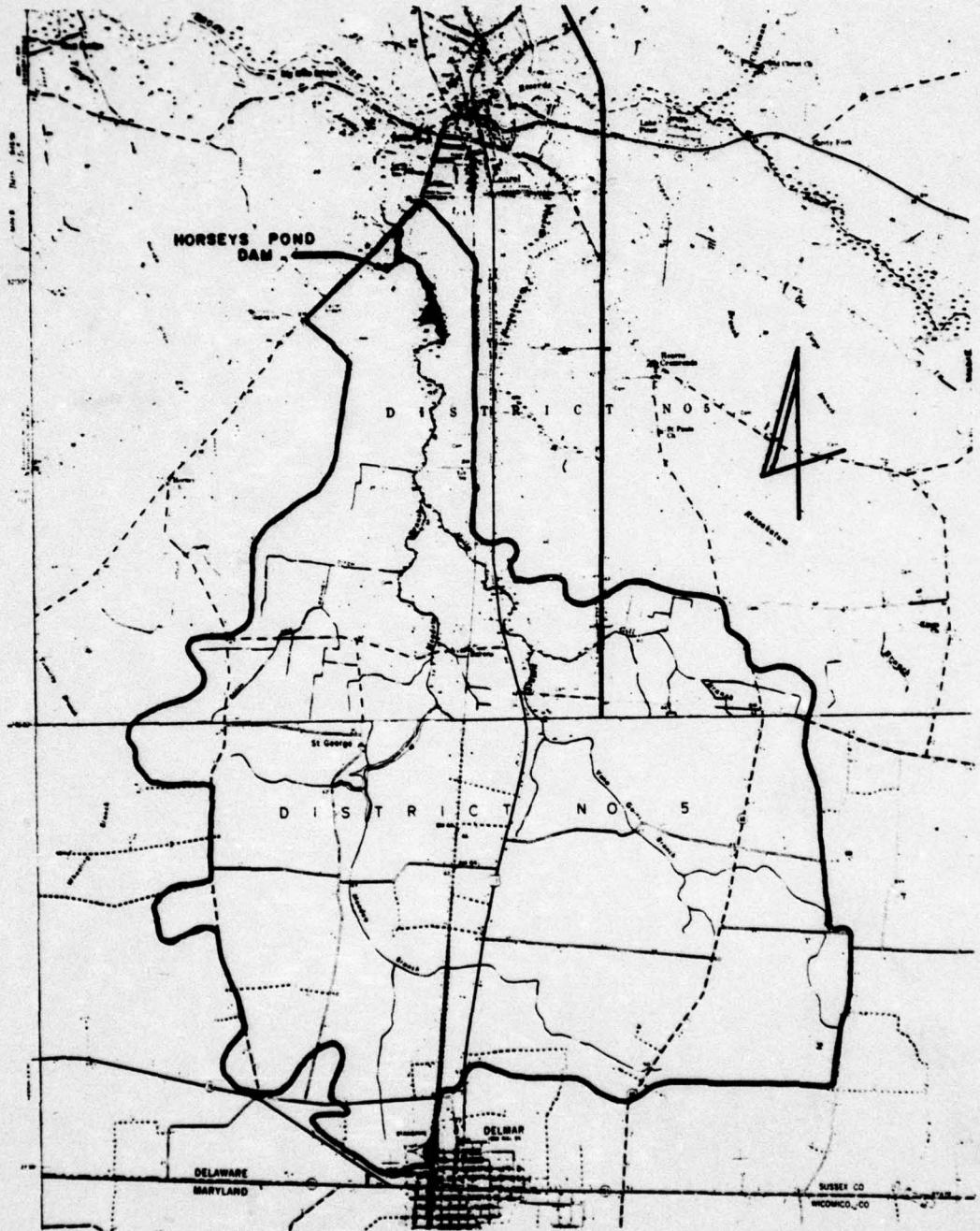
HYDROMETEOROLOGICAL GAGES: None

- a. Type N/A
- b. Location N/A
- c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE: 1609 CFS @ El. 24.4

APPENDIX D

HYDROLOGIC COMPUTATIONS

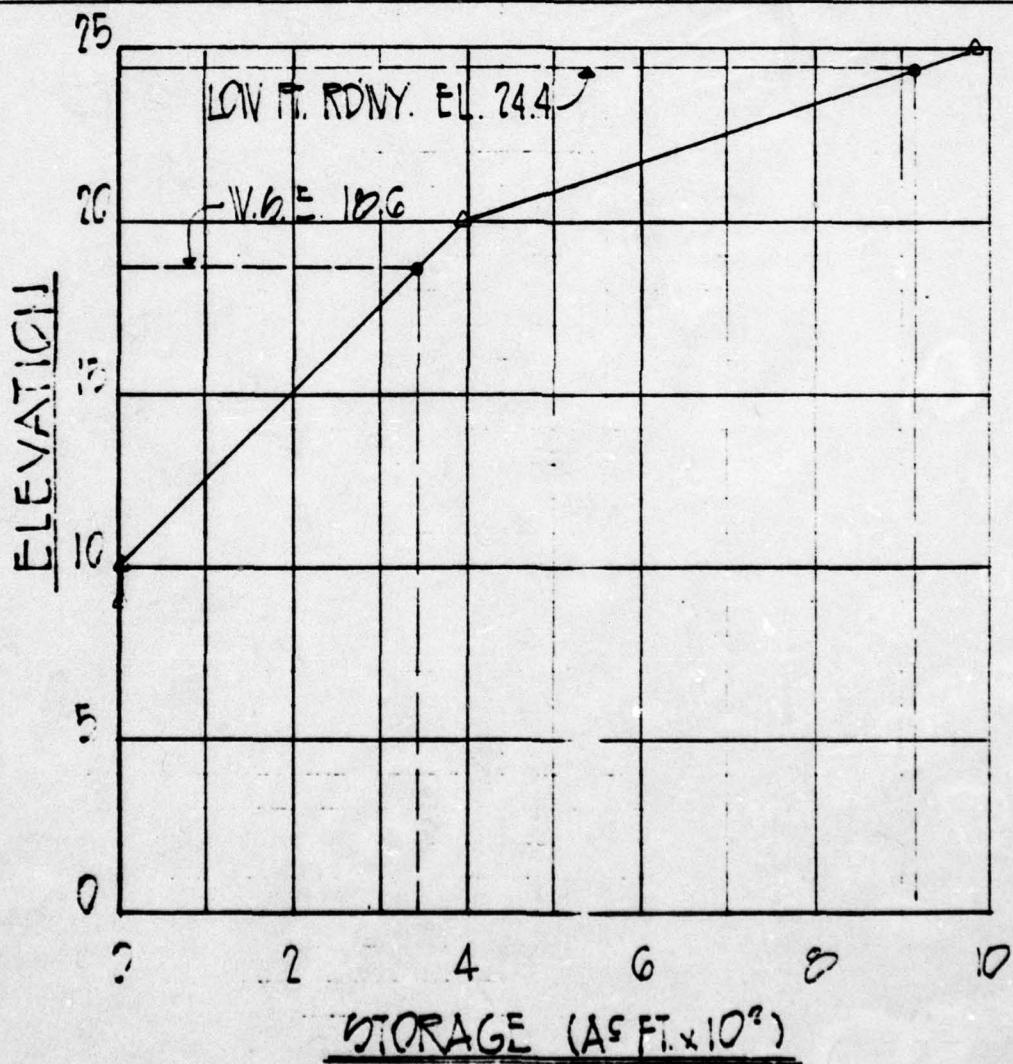


WATERSHED MAP

HORSEYS POND DAM

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ELEV	AREA (FT ²)	AVG. AREA (FT ²)	DEPTH (FT)	VOL. (FT ³)	Σ VOL (FT ³)	Σ VOL (A ² FT)
9:	0	6,650	1	6,650	0	0
10	13,300	1,716,650	10	17,166,500	6,650	0.15
20	3,440,000	5,100,000	5	25,500,000	17,273,150	396.5
25	6,760,000				42,773.5	981.5



ct N° <u>300.30</u>	C.A.R. Calculated By <u> </u>	12/5/78 Date	Calculations For: <u>STAGE-STORAGE</u> <u>HORSEY'S POND</u> <u>DATA OBTAINED FROM QUAD</u>	Sheet <u>1</u> of <u> </u>
	Checked By <u> </u>	Date		

THOMAS TYLER MOORE ASSOCIATES, INC.
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STAGE-DISCHARGE CALCULATIONS FOR TWIN 9'x7.5' BOX
CULVERT UNDER INLET CONTROL AND WEIR FLOW OVER
ROADWAY.

BOX CULVERT DATA:

INV. ELEV. = 6.3

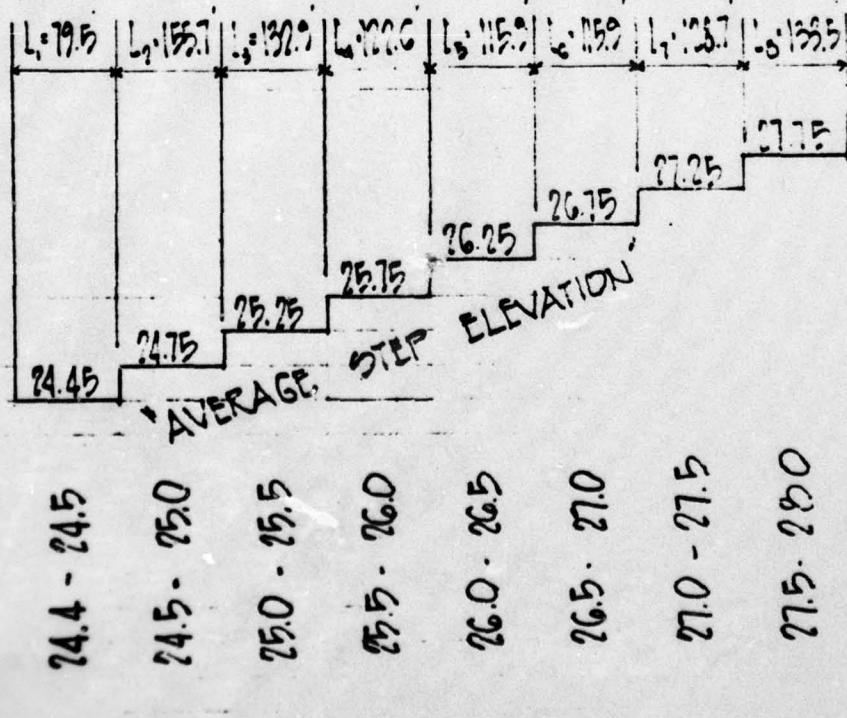
D = 7.5'

D = 2 x 9.18'

TYPE (I) ENTRANCE CONDITION

WEIR FLOW OVER RD'IVY BEGINS AT ELEV. 24.4

EFFECTIVE WEIR LENGTH AND ELEV USED IN ANALYSIS



Calculations For:

Sheet 2

of —

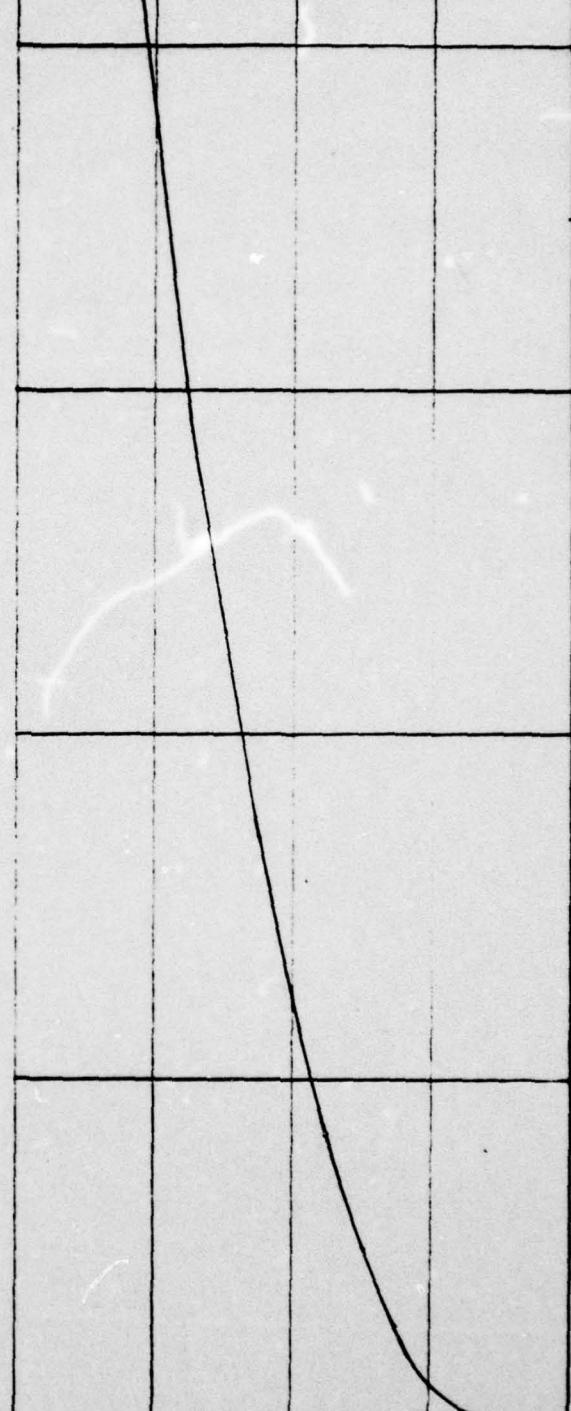
WEIR FLOW OVER RDIVY. Q = CLH²

H ₂ O	H ₂ S	H ₂ N	H ₂ N	H ₂ S	Q ₁	Q ₂	Q ₃	Q ₄	Q ₅	Q ₆	Q ₇	Q ₈	Q ₉	Q ₁₀	Q ₁₁	Q ₁₂	Σ Q	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
025	0	0	0	0	33	0	33	0	33	0	0	0	0	0	0	0	0	33
1.00	0.35	0	0	0	149	142	0	0	0	0	0	0	0	0	0	0	0	291
1.84	1.00	0.35	0	0	306	405	121	0	0	0	0	0	0	0	0	0	0	832
2.83	1.84	1.00	0.35	0	490	145	346	112	0	0	0	0	0	0	0	0	0	1701
3.31	2.32	1.40	0.65	0.13	969	1999	978	586	301	105	0	0	0	0	0	0	0	2917
					1288	2105	1365	902	554	301	117	0	0	0	0	0	0	4532
					1383	2377	1576	1074	699	422	218	45	0	0	0	0	0	6582
					1383	2377	1576	1074	699	422	218	45	0	0	0	0	0	7769

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"WEIR FLOW OVER ROADWAY"



4

3

2

1

DISCHARGE ($CU\text{M}/C^3$)

0

ELEVATION

100

91

86

81

74

Set No:

Calculated By _____

Date _____

Checked By _____

Date _____

Calculations For:
STAGE-DISCHARGE
WEIR FLOW OVER RD/WY.

Sheet

of

4

1

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H.W./D (ASSUME)	RATIO Q/B (READ)	Q. RATIO x B (CALC. IN C.F.S.)	H.W. + H.W./D x 7.5 (CALC. IN FT.)	H.W. EL. + G.3 + H.W
0.53	74	432	4.0	10.3
0.67	33	594	5.0	11.3
0.8	44	792	6.0	12.3
0.93	54	972	7.0	13.3
1.06	64	1152	8.0	14.3
1.2	75	1350	9.0	15.3
1.33	85	1530	10.0	16.3
1.47	93	1674	11.0	17.3
1.6	100	1800	12.0	18.3
1.75	108	1944	13.0	19.3
1.87	115	2070	14.0	20.3
2.0	120	2160	15.0	21.3
2.13	125	2250	16.0	22.3
2.27	132	2370	17.0	23.3
2.41	138	2484	18.1	24.4
2.47	140	2520	18.5	24.8
2.53	142	2556	19.0	25.3
2.6	148	2664	19.5	25.8
2.67	150	2700	20.0	26.3
2.73	152	2736	20.5	26.8

Calculated By	Date	Calculations For: <u>STAGE-DISCHARGE</u> <u>HORSEY'S POND</u> <u>IVIN 9'x15' BOX CULVERT INLET CONTROL</u>	Sheet <u>5</u>
Checked By	Date		01

THOMAS TYLER MOORE ASSOCIATES, INC.
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2.80	155	2790	21.0	27.3
2.87	157	2826	21.5	27.8
2.89	158	2844	21.7	28.0

COMBINED FLOWS THROUGH TWIN 9'x7.5' BOX CULVERT (INLET CONTROL)
PLUS WEIR FLOW OVER RD'WY.

ELEV	Q (BOX CULVERT) (CFS.)	Q (RD'WY.) (CFS)	Q ACCUM. (CFS)
24.4	2484	0	2484
24.8	2520	33	2553
25.3	2556	291	2847
25.8	2664	832	3496
26.3	2700	1701	4401
26.8	2736	2917	5653
27.3	2790	4538	7328
27.8	2826	6582	9408
28.0	2844	7189	10633

N ^o	Calculated By	Date	Calculations For: <u>STAGE - DISCHARGE</u> <u>COMBINED INLET CONTROL & RD'WY.</u>	Sheet <u>6</u> of _____
	Checked By	Date		

$$\frac{1}{2} PHT = 600 + CFS$$

STREAM CAPACITY CALCULATIONS DESIGN: RHT 1-3-79

STATION 65' Below Rd CHECKED:

HORSEY'S POND DAM

$$S_0 = \underline{0.0013}$$

$$\text{Channel } n = \underline{.035}$$

$$V = \frac{1.49}{n} \times R^{2/3} \times S^{1/2} = 1.57 \times R^{2/3}$$

$$\text{Flood Plain } n = \underline{.040}$$

$$V = \frac{1.49}{n} \times R^{2/3} \times S^{1/2} = 1.34 \times R^{2/3}$$

CHANNEL INVERT ELEV. 7.4

	D	A	P	R	$R^{2/3}$	V	Q	Q_{total}
CHANNEL	+2 (E.L.9A)	34.33	33.3	1.031	1.02	1.56	53.6	53.6
	+4 (E.L.11A)	96.3	36.3	2.65	1.92	2.94	283.1	290.1
	+6 (E.L.13A)	162.7	36.9	4.41	2.69	4.12	670.3	815.12
	+8 (E.L.15A)	218	36.9	5.91	3.27	5.00	1090	1800
	+10 (E.L.17A)	283.7	36.9	7.68	3.90	5.97	1693.5	3537.5
PLAINS	+4 (E.L.11A) R	7.6	13.2	0.58	0.69	0.92	6.99	
	+6 (E.L.13A) R	8.0	9.5	0.84	0.89	1.19	9.52	
	+6 (E.L.13A) L	78.7	54.3	1.45	1.28	1.72	135.3	
	+8 (E.L.15A) R	44.7	23.2	1.93	1.55	2.07	92.5	
FLOOD PLAINS	+8 (E.L.15A) L	254.7	102.3	2.49	1.84	2.46	626.5	
	+10 (E.L.17A) R	109.3	39.2	2.78	1.98	2.65	789.6	
	+10 (E.L.17A) L	464.0	117.1	3.96	2.50	3.35	1554.4	

PHOTO 6

SIMPLIFIED CALCULATIONS

STATION 65' Below Koar

HOKSETT & FOND DAM

$$S_0 = \underline{0.0013}$$

Channel n = .035

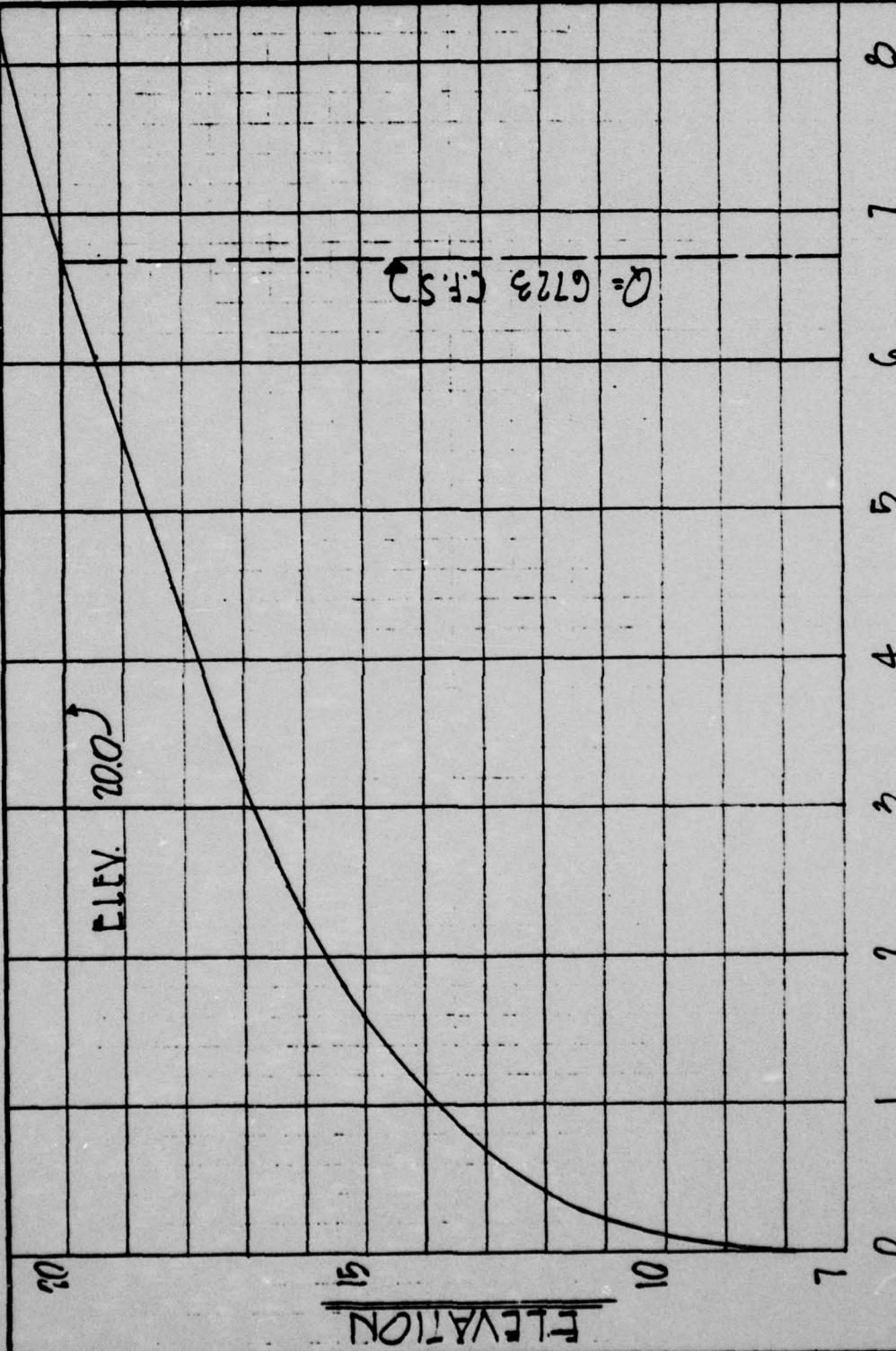
$$V = \frac{1.49}{n} \times R^{2/3} \times S^{1/2} = 1.53 R^{2/3}$$

Flood Plain n = .040

$$V = \frac{1.49}{\pi} \times R^{2/3} \times S^{1/2} = 1.34 R^2$$

CHANNEL INVERT ELEV. 7.4

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS



1 N²
105.301

CAR
Calculated By _____
Checked By _____

1/10/79
Date

Date

Calculations For:
STAGE-DISCHARGE
CHANNEL SECTION 6.5 FT FROM
MOUTH OF CULVERT

Sheet 9
of 1

THOMAS TYLER MOORE ASSOCIATES, INC.
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STAGE-DISCHARGE CALCULATIONS FOR TWIN 9'x7.5' BOX
CULVERT UNDER OUTLET CONTROL AND WEIR FLOW OVER RDWY

BOX CULVERT DATA:

L = 81 FT

i = 0.25%

K_e = 0.4

n = 0.015

D = 7.5'

B = 10'

$$d_c = 0.315 \sqrt[3]{(Q/B)^2}$$

$$H = \left[1 + K_e + \frac{29 R^{1/2} L}{R^{1/3}} \right] V^{3/2} g$$

$$H = \left[1 + 0.4 + \frac{29 \times (0.015)^{1/2} \times 81}{(2.045)^{1/3}} \right] V^{3/2} / 64.4$$

$$H = 0.025 V^2$$

$$H.W = H + h_o (\text{ORI}) - L.S.$$

N^o

Calculated By _____

Date _____

Calculations For:

Checked By _____

Date _____

Sheet

10

of

THOMAS TYLER MOORE ASSOCIATES, INC.
 PROFESSIONAL ENGINEERS AND LAND SURVEYORS

Q	dc	dc + D/2	ho	EL. ho	TN	EL TN	A	V	H	LS	H.W.	EL. H.W
432	2.6	5.1	5.1	11.7	6.1	12.2	1028	3.9	0.4	0.2	6.3	12.6
594	3.2	5.4	5.4	11.5	6.6	12.1	1182	5.0	0.6		7.0	13.3
794	3.9	5.7	5.7	11.8	7.1	13.2	177.0	6.2	1.0		7.9	14.2
972	4.5	6.0	6.0	12.1	7.7	13.8	1350	7.2	1.3		8.8	15.1
1152	5.0	6.3	6.3	12.4	8.1	14.2		8.5	1.8		9.7	16.0
1350					8.5	14.6		10.0	2.5		10.8	17.1
1530					8.8	14.9		11.3	3.2		11.8	18.1
1674					9.1	15.2		12.4	3.8		12.7	19.0
1800					9.3	15.4		13.3	4.4		13.5	19.8
1944					9.5	15.6		14.4	5.2		14.5	20.8
2070					9.6	15.7		15.3	5.8		15.2	21.5
2160					9.7	15.8		16.0	6.4		15.9	22.2
2250					9.9	16.0		16.7	7.0		16.7	23.0
2376	<u>BEGIN COMBINED FLOW</u>				10.0	16.1		17.6	7.7		17.5	23.8
	'Q' WEIR		COMBINED 'Q'									
2450	0	2450		10.1	16.2		18.1	8.2		18.1	24.4	
2475	25	2500		10.2	16.3		18.3	8.4		18.4	24.7	
2490	60	2550		10.2	16.3		18.4	8.5		18.5	24.8	
2500	150	2650		10.4	16.5		18.5	8.6		18.8	25.1	
2510	240	2750		10.5	16.6		18.6	8.6		18.9	25.2	
2515	485	3000		10.7	16.8		18.6	8.7		19.2	25.5	

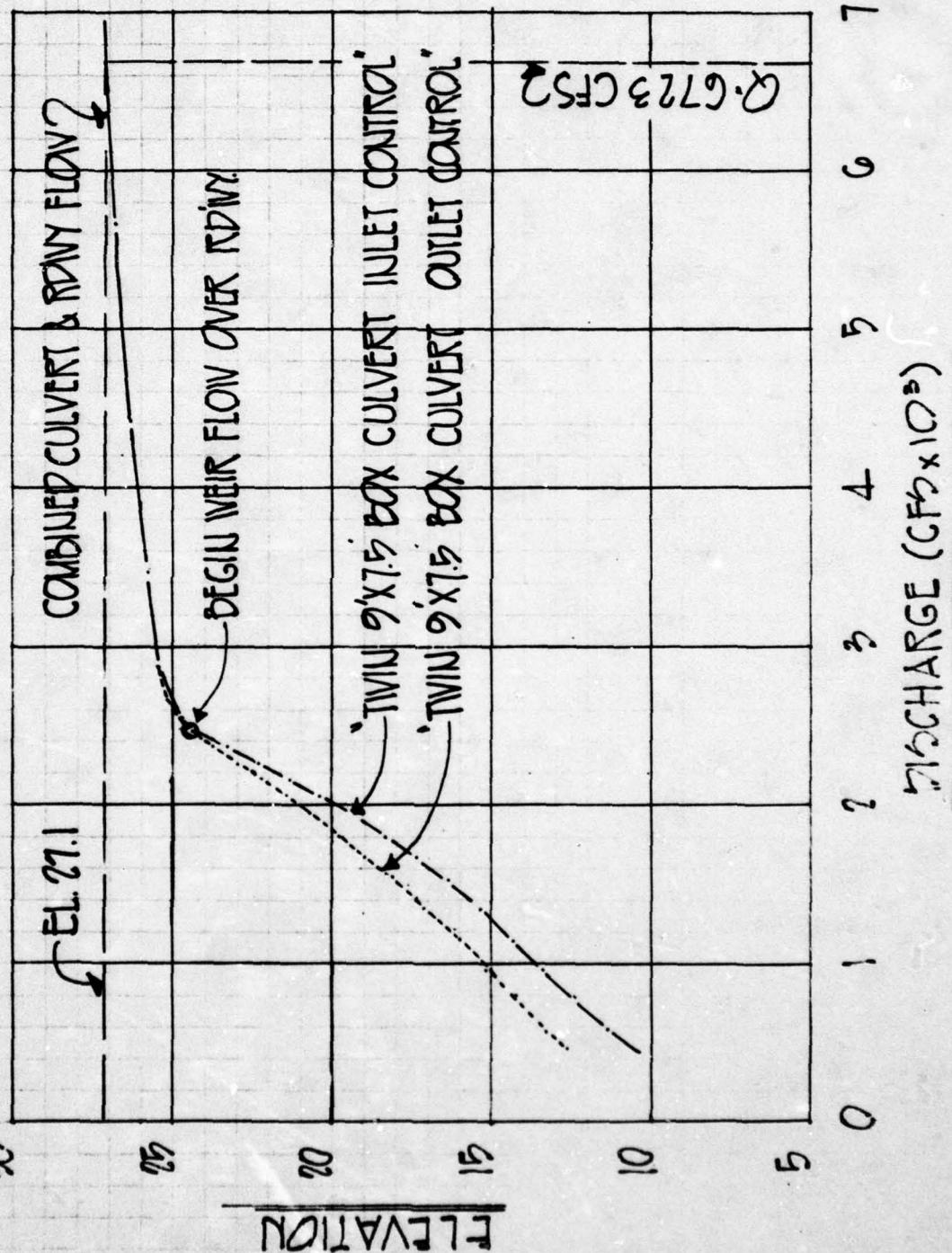
N2	Calculated By	Date	Calculations For:	Sheet	11
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THOMAS TYLER MOORE ASSOCIATES, INC.
 PROFESSIONAL ENGINEERS AND LAND SURVEYORS

2490	1010	3500	11.2	17.3	135	18.4	05	0.2	19.5	25.8
2415	1525	4000	11.6	17.7	183	18.3	84		19.8	26.1
2440	2060	4500	12.1	18.2	181	18.1	8.2		20.1	26.4
2415	2485	5000	12.5	18.6	17.9	17.9	0.0		20.3	26.6
2390	3110	5500	12.9	19.0	17.7	17.7	7.8		20.5	26.8
2340	3660	6000	13.3	19.4	17.3	17.3	7.5		20.6	26.9
2305	4195	6500	13.7	19.8	17.1	17.1	7.3		20.8	27.1
2280	4720	7000	14.1	20.2	16.9	16.9	7.1		21.0	27.3

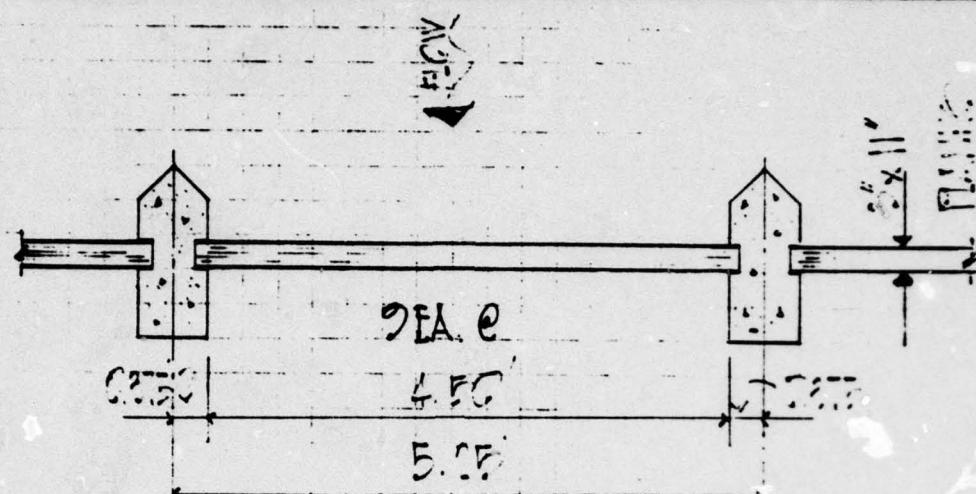
1 No	Calculated By	Date	Calculations For:	Sheet	12
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THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

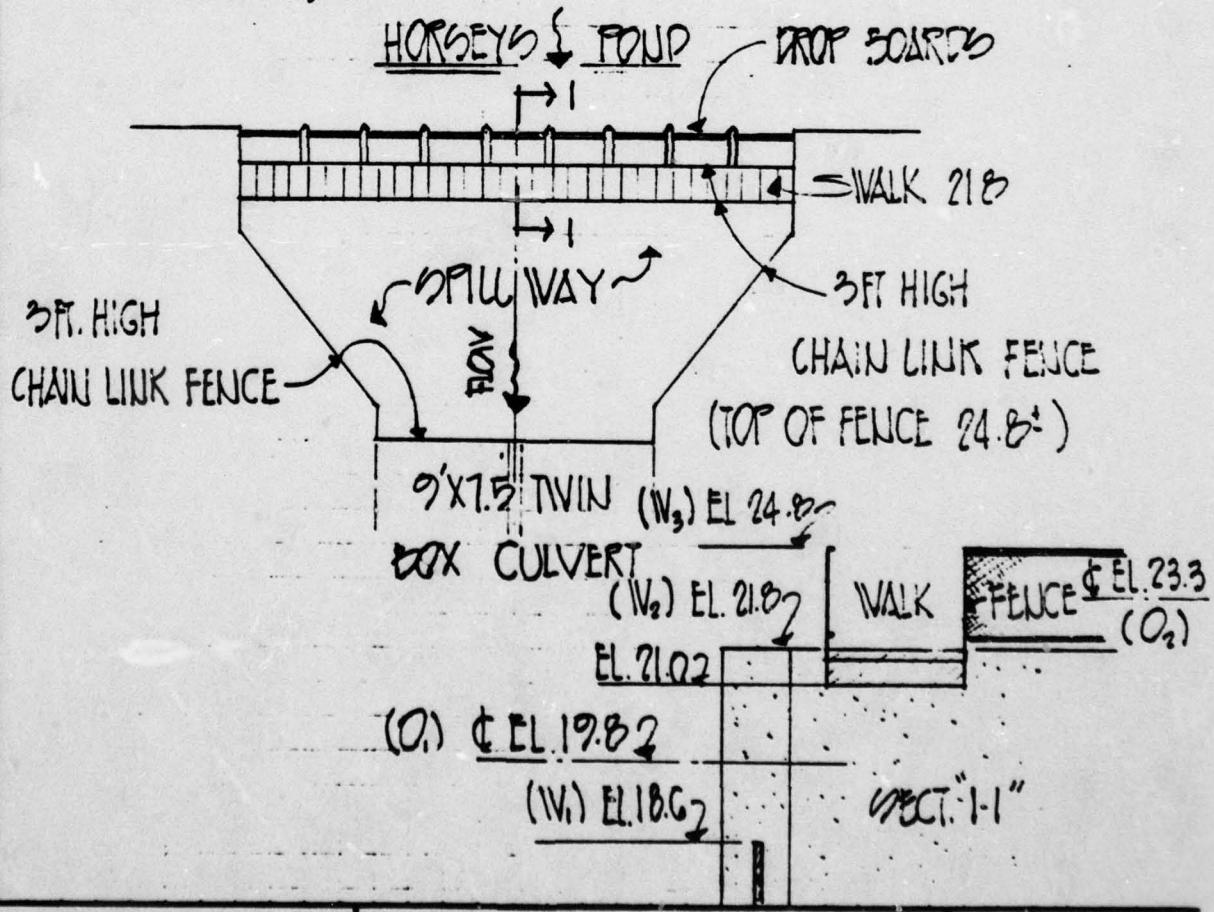


1 N ²	Calculated By _____	Date _____	Calculations For: RATING CURVE TWIN 9'X15' BOX CULVERT WITH RDWY FLOW	Sheet <u>13</u> of <u>1</u>
	Checked By _____	Date _____		

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS



6 @ EL. 18.8
3 @ EL. 18.4 } USE 18.6 FOR ANALYSIS C = 3.3



N^o

Calculated By _____
Checked By _____

Date _____
Date _____

Calculations For:
HORSEYS POND
PRINCIPAL SPILLWAY

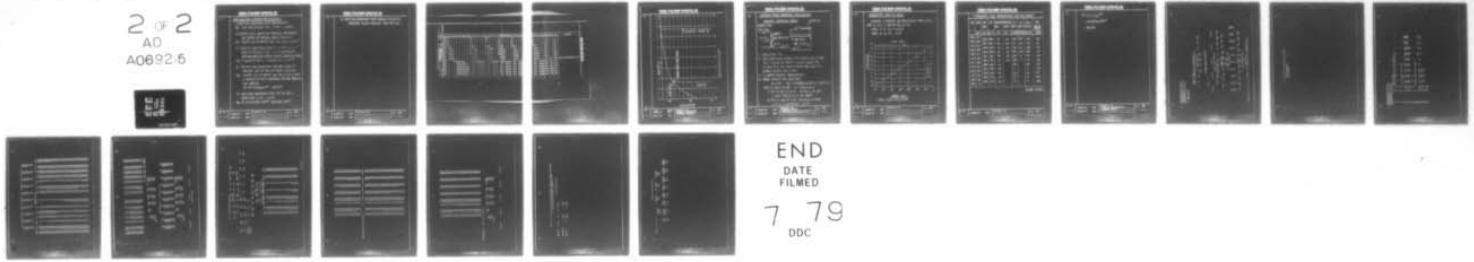
Sheet 14
of —

AD-A069 215 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. HORSEYS POND DAM (DE 00022). NANTI--ETC(U)
APR 79 T T MOORE DACW61-78-C-0124

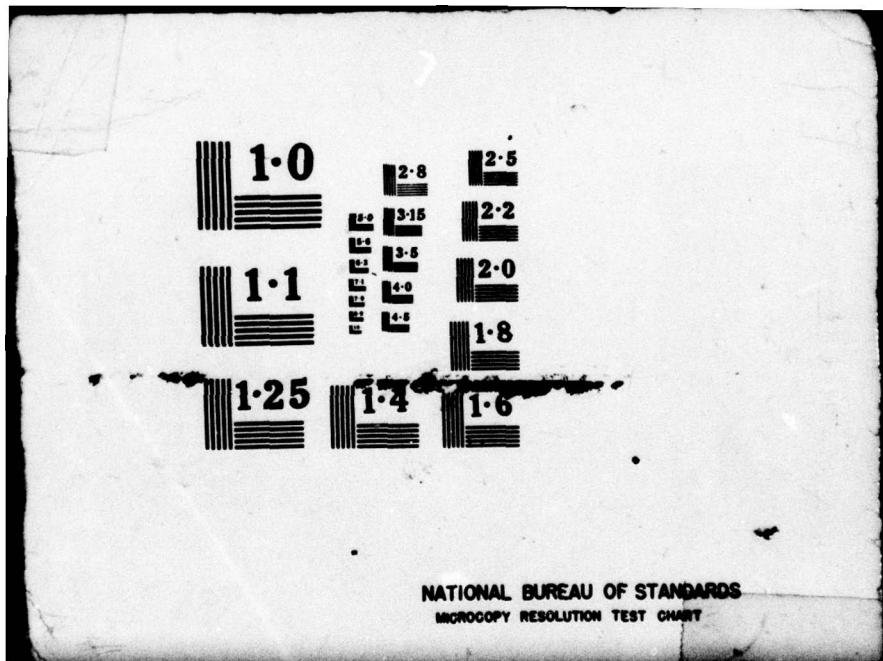
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2 OF 2
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THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

FOR ANALYSIS CONSIDER THE FOLLOWING:

1.) WEIR FLOW CONDITIONS OVER DROP BOARDS

(W₁) ELEV. 18.6 TO ELEV. 21.0, C=3.3, L=40.5 FT

2.) ORIFICE FLOW CONDITIONS BETWEEN DROP BOARDS

AND BOTTOM OF SIDEWALK BEAM @ ELEV. 21.0

(O₁) CENTER LINE OF ORIFICE ELEV. 19.3, C_o=0.6, A=97.2 FT²

3.) WEIR FLOW CONDITIONS OVER TOP OF SIDEWALK AND

SIDES OF SPILLWAY @ ELEV 21.8 TO COMPENSATE

FOR AREA REDUCTION, CLOGGING FACTOR & SUBMERGENCE REDUCE

(W₂) "C" VALUE BY 50%. C=2.6x0.5=1.3, L=111.0 FT

4.) ORIFICE FLOW CONDITIONS BETWEEN SIDES OF

SPILLWAY AND TOP RAIL OF FENCE @ ELEV. 24.8

(O₂) CENTER LINE OF ORIFICE ELEV. 23.3, C_o=0.3, A=333 FT²,

C_o REDUCED BY 50% TO COMPENSATE FOR AREA REDUCTION
AND CLOGGING.

$$Q = 0.3(111 \times 3)(64.4 H)^{1/2} = 802(H)^{1/2}$$

5.) WEIR FLOW CONDITIONS OVER TOP OF FENCE

@ ELEV. 24.8, C=3.3, L=111.0 FT

(W₃) Q= 3.3(111)(ELEV. 24.8)^{3/2} = 366.3 (ELEV. 24.8)^{3/2}

ject N^o

Calculated By

Date

Calculations For:

Sheet

15

Checked By

Date

or

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

6) WEIR FLOW CONDITIONS OVER ROADWAY @ ELEV. 24.4
DISCHARGE VALUES OBTAINED FROM PG'S. 3 & 4.

N^o

Calculated By

Date

Calculations For:

Checked By

Date

Sheet 16

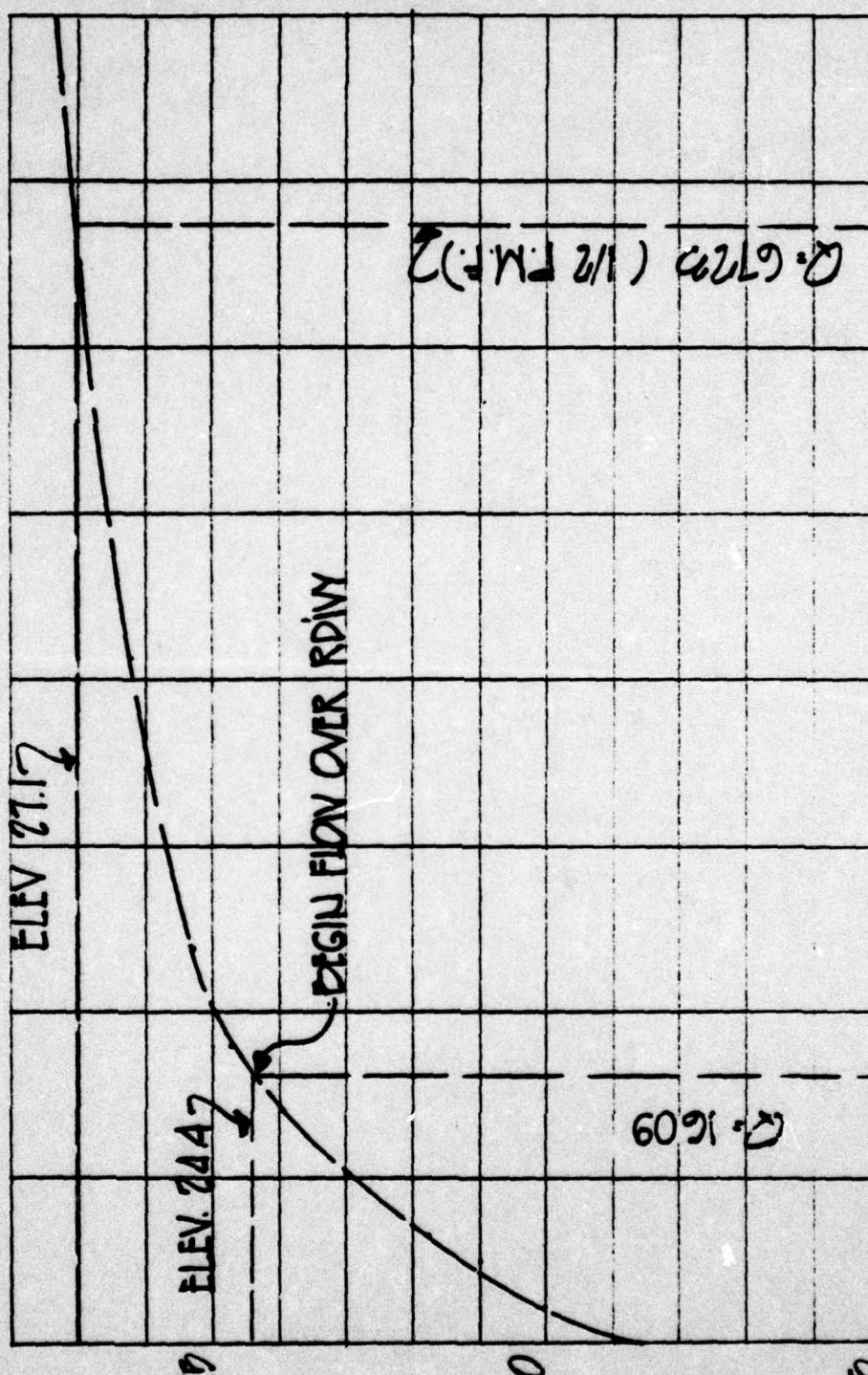
of _____

EL.	H _w	H _o	H _{os}	H _{os}	H _{ws}	T.N.	ΔH _w	ΔH _o	ΔH _{os}	C _m	C _o	C _{ws}	C _{os}	C _w /C _o	L _m	A _o	L _{os}	A _{os}	L _{ws}	H _w [%]	H _o [%]	H _{os} [%]	H _{ws} [%]	Q _m	Q _o	Q _{os}	Q _{ws}	Q _o
10.0	0									3.3					40.5					0				0				
19.0	0.4																			0.13				33				
20.0	1.4																			1.66				222				
21.0	2.4	1.2																		3.12	0.77			497	512			
21.0	2.0	0																		5.72	1.35	0		662	677			
22.0	2.2	0.2																		6.77	1.70	0.07		634	649			
23.0	3.2	1.2																		9.73	1.45	1.31		857	872			
24.0	4.2	2.2																		16.15	3.26			739	754			
24.75	4.95	2.95																		17.65	5.07			1041	1056			
25.75			1.95	0.45	2.15	3.45														14.71	6.41	11.81	0.30	810	825			
26.75			1.45	24.2	2.05	2.05														11.49		11.49	1.75	670	685			
26.75			1.95	25.0	1.75	1.75	0.1													10.62		10.62	2.72	619	634			
27.75			2.45	25.5	1.75	1.75	0.3													10.62		10.62	3.83	619	634			
27.75			2.95	25.9	1.85	1.85	0.4													10.92		10.92	5.07	637	652			
28.0			3.2	26.0	2.0	2.0	0.4													11.35		11.35	5.72	662	677			

Q_a	Q_{a_1}	Q_{a_2}	Q_{a_3}	$\Sigma Q_{a_i} + Q_{out}$	Q_{out}	ΣQ_{out}	COMMENTS
0				0		0	
33				33		33	
22				22		22	
17	52	0		497		497	
662	0			662		662	
694	12			707		707	
857	107			1026		1026	
750	410			1429		1429	
1041	132			1773	33	1806	DEGIN FLOW OVER RDNY @ H 24.4
810	1119	110		2099	291	2390	
610	1140	641		2459	1701	4160	
619	1061	976		2676	2917	5593	
619	1061	1023		3083	4530	7621	
637	1071	1051		3585	6582	10167	
662	1024	2075		3891	7189	11680	

THOMAS TUDOR HOWE, ASSOCIATES, INC.
HYDRAULIC CONSULTANTS AND ENGINEERS

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS



STAGE-DISCHARGE CURVE FOR HORSESHOE POND

N ^o	Calculated By	Date	Calculations For:	Sheet
			STAGE-DISCHARGE HORSESHOE POND	10 of

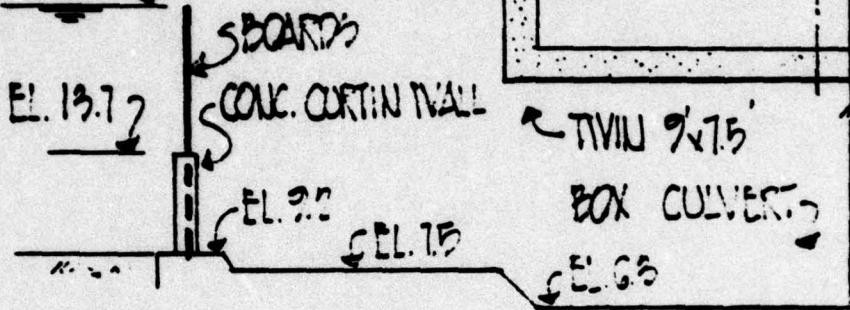
HORSEYS POND - DRAWDOWN CALCULATIONS

CONSIDER CONDITIONS SHOWN:

\$C RTE. 24

HORSEYS POND

V.S.E. 18.6



- 1.) INITIAL V.S.E. 18.6
- 2.) CONC. CURTAIN WALL EXTENTS FROM EITHER ABUTMENT FOR TOTAL DISTANCE OF $57.5 \pm \text{ft.}$ (12' WEIR LENGTH FROM EL. 18.6 TO EL 13.7 + $4.5' \times 7 = 31.5 \text{ ft.}$ WEIR LENGTH FROM EL. 18.6 TO EL. 9.2 + $4.5' \times 2 = 9 \text{ ft.}$)
- 3.) ALL BOARDS REMOVED INSTANTANEOUSLY
- 4.) BROAD-CRESTED WEIR CONDITIONS:

$$Q = CLH^{3/2} \quad \text{USE: } C=3.3 \text{ (FROM EL. 18.6 TO 13.7)} \& C=0.6 \text{ (FROM EL. 13.7 TO 9.2)}$$

$$\text{EFFECTIVE LENGTH OF WEIR: } L = L' - 2(NK_p + K_s)H_e$$

$$\text{A) FROM EL. 18.6 TO EL 13.7 USE AVG } H_e \text{ OF } 24.5 \text{ FT.}$$

$$L = 31.5 - 2(8 \times 0.0 + 0.2)24.5 = 30.5 \text{ FT.}$$

$$\text{B) FROM EL. 18.6 TO EL. 9.2 USE AVG. } H_e \text{ OF } 4.7 \text{ FT.}$$

$$L = 9 - 2(1 \times 0.0 + 0.2)4.7 = 7.1 \text{ FT.}$$

Calculated By _____

Date _____

Checked By _____

Date _____

Calculations For:
HORSEYS POND
DRAWDOWN CALCULATIONS

Sheet 19

of _____

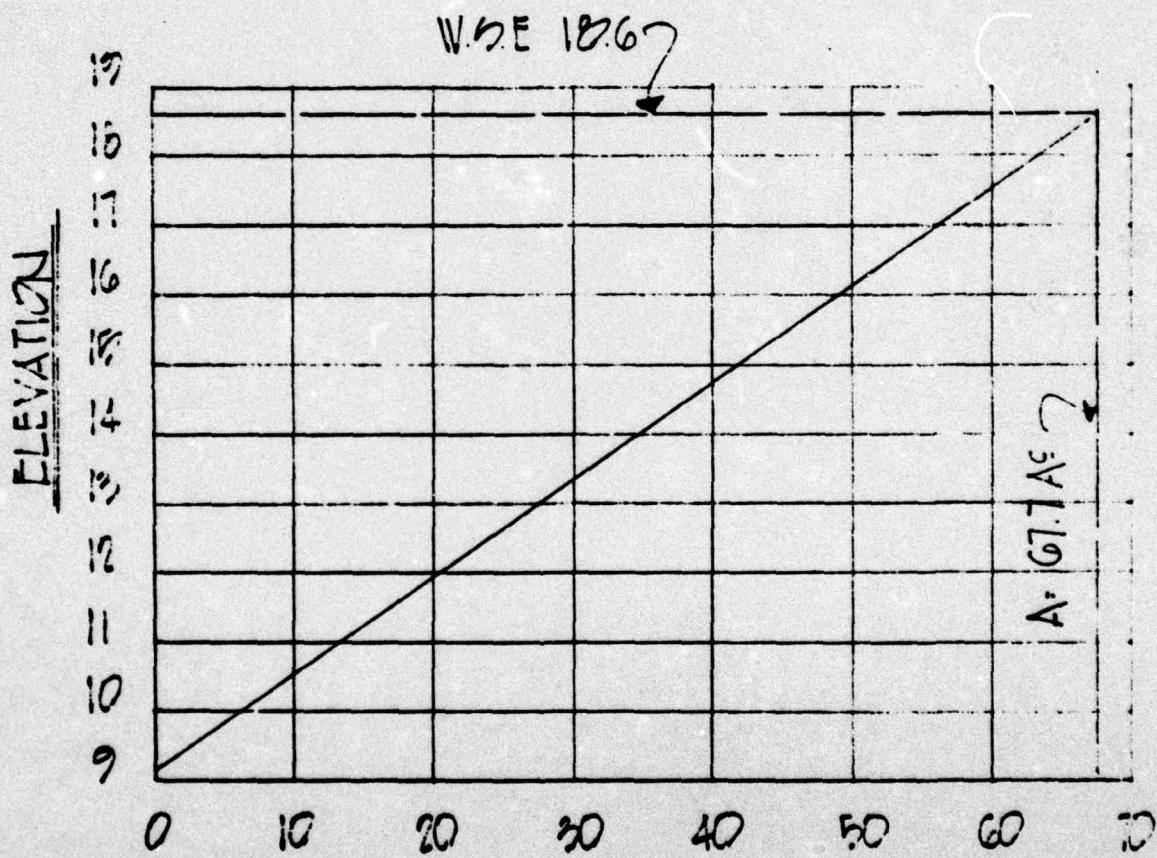
THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

RESERVAR AREA VS HEAD

ASSUME A STRAIGHT LINE RELATIONSHIP FROM NORMAL
POOL EL. 10.6 TO TOP OF SILL EL. 9.2

AREA AT EL. 10.6 = 67.7² AC

AREA AT EL 9.2 = 0 AC.



AREA - AC.
AREA = (ELEV. - 9.2) / 0.139

Oct N ^o	Calculated By	Date	Calculations For:	Sheet <u>20</u>
	Checked By	Date		of —

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

'DRAWDOWN TIME COMPUTATIONS WITH NO INFLOW'

ELEV.	AREA	Avg. Area	VOL.	HEAD ON V, WEIR '1'	HEAD ON V, WEIR '2'	Q ₁ , WEIR '1'	Q ₂ , WEIR '2'	Q _{total} (Q ₁ +Q ₂)	TIME $\frac{VOL \times 24}{1.98 \times Q}$
	(A ²)	(A ₂)	(A ² FT)	(FT)	(FT)	(FT ³ /SEC)	(FT ³ /SEC)	(FT ³ /SEC)	(HRS)
10.6	67.7	65.5	39.3	9.1	4.6	501	993	1494	0.32
10.0	63.3	59.7	59.7	8.3	3.8	441	146	587	0.61
17.0	56.1	52.5	52.5	7.3	2.8	364	472	836	0.76
16.0	48.9	45.3	45.3	6.3	1.8	292	243	535	1.03
15.0	41.7	38.1	38.1	5.3	0.8	225	72	297	1.55
14.0	34.5	33.4	10.0	4.7	0.2	180	9	197	0.62
13.7	32.4	29.8	20.9	4.2		159		159	1.59
13.0	27.3	23.7	23.7	3.3		111		111	2.59
12.0	20.1	16.5	16.5	2.3		64		64	3.12
11.0	12.9	9.3	9.3	1.3		27		27	4.18
10.2	5.8	2.9	2.3	0.4		5		5	5.50
9.2	0								

Σ TIME = 22.0 HRS.

Job No:	Calculated By _____	Date _____	Calculations For:	Sheet <u>21</u> of <u>21</u>
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THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

$$\begin{aligned} \text{TP} &= C_f (L \times L_{C2})^{0.3} \\ &= 3.0 (8.24 \times 3.93)^{0.3} \\ &= 8.5 \text{ HR.} \end{aligned}$$

Oct N^o

Calculated By

Date

Checked By

Date

Calculations For:
TIME OF CONCENTRATION
HORSEYS POND

Sheet 22

of —

DATA 79/02/21.

FLOOD HYDROGRAPH WALKER (MFL-1)
DAM SAFETY VERSION JNL-V 1-74
LAST MODIFICATION 21 JUN. 74

MURKIN & MUNN, LTD.
PHASE I LAW INSPECTION - STATE OF DELAWARE
MURKIN, RENNER, THOMAS, TILLEN MUNN ASSOCIATES

JOURNAL OF SPECIFICATION

MULTI-PLAN ANALYSES TO BE PERFORMED

RECESSION DATA
 $\Delta t_{10\%} = 0.00$ $\Delta t_{CSN} = 0.00$ $RT10\% = 1.00$
 $\Delta t_{CSN} = 0.00$ $\Delta t_{10\%} = 0.00$ $RT10\% = 1.00$
INTERVALS

PRINTED IN SEQUENCE OF STREAM NETWORK CALCULATIONS

PUNOFF HYDROGRAPH AT
1
PUNOFF HYDROGRAPH TO
2
END OF NF TABLE

FLOOD HYDROGRAPH PACKAGE (HEC-1)

DAM SAFETY VERSION

JULY 1978

LAST MODIFICATION

21 AUG 78

sequoia

1	A1	HORSEY'S POND DAM	PHASE I	DAM INSPECTION -- STATE OF INELAMATE
2	A2		WALTER A. KENNEDY, THOMAS TYLEK MOUNT ASSOCIATES	
3	A3			
4	B	120	"	0
5	C	50	"	0
6	D	0	"	0
7	E	1	"	0
8	F	1	"	0
9	G	0	HYDROGRAPH TO HORSEY'S POND	0
10	H	1	15.35	0
11	I	0	4.8	0
12	J	0.055	0.055	0.065
13	K	0.008	0.01	.01
14	L	0.023	0.048	.072
15	M	0.015	0.009	.009
16	N	0.006	0.006	.006
17	O	1.0		1.0
18	P	6.5		
19	Q	0.0	0.0	1.0
20	R	1	"	
21	S	HORSEY'S POND DAM	ROUTE FLOWS THROUGH HORSEY'S POND	0
22	T	1	1	0
23	U	1	1	1
24	V	19.6	19.6	20.0
25	W	24.75	24.75	26.25
26	X	0	33	175
27	Y	1806	1840	2389
28	Z	0	397	982
29	A	0	211	25
30	B	35	18.6	
31	C	32	26.4	
32	D	0	0.9	

251.	250.	249.	248.	247.	246.	245.	244.	243.	242.	241.	240.	239.	238.	237.	236.	235.	234.	233.	232.	231.	230.	229.	228.	227.	226.	225.	224.	223.	222.	221.	220.	219.	218.	217.	216.	215.	214.	213.	212.	211.	210.	209.	208.	207.	206.	205.	204.	203.	202.	201.	200.	199.	198.	197.	196.	195.	194.	193.	192.	191.	190.	189.	188.	187.	186.	185.	184.	183.	182.	181.	180.	179.	178.	177.	176.	175.	174.	173.	172.	171.	170.	169.	168.	167.	166.	165.	164.	163.	162.	161.	160.	159.	158.	157.	156.	155.	154.	153.	152.	151.	150.	149.	148.	147.	146.	145.	144.	143.	142.	141.	140.	139.	138.	137.	136.	135.	134.	133.	132.	131.	130.	129.	128.	127.	126.	125.	124.	123.	122.	121.	120.	119.	118.	117.	116.	115.	114.	113.	112.	111.	110.	109.	108.	107.	106.	105.	104.	103.	102.	101.	100.	99.	98.	97.	96.	95.	94.	93.	92.	91.	90.	89.	88.	87.	86.	85.	84.	83.	82.	81.	80.	79.	78.	77.	76.	75.	74.	73.	72.	71.	70.	69.	68.	67.	66.	65.	64.	63.	62.	61.	60.	59.	58.	57.	56.	55.	54.	53.	52.	51.	50.	49.	48.	47.	46.	45.	44.	43.	42.	41.	40.	39.	38.	37.	36.	35.	34.	33.	32.	31.	30.	29.	28.	27.	26.	25.	24.	23.	22.	21.	20.	19.	18.	17.	16.	15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.	0.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
27-11	27-10	27-9	27-8	27-7	27-6	27-5	27-4	27-3	27-2	27-1	27-0	26-9	26-8	26-7	26-6	26-5	26-4	26-3	26-2	26-1	26-0	25-9	25-8	25-7	25-6	25-5	25-4	25-3	25-2	25-1	25-0	24-9	24-8	24-7	24-6	24-5	24-4	24-3	24-2	24-1	24-0	23-9	23-8	23-7	23-6	23-5	23-4	23-3	23-2	23-1	23-0	22-9	22-8	22-7	22-6	22-5	22-4	22-3	22-2	22-1	22-0	21-9	21-8	21-7	21-6	21-5	21-4	21-3	21-2	21-1	21-0	20-9	20-8	20-7	20-6	20-5	20-4	20-3	20-2	20-1	20-0	19-9	19-8	19-7	19-6	19-5	19-4	19-3	19-2	19-1	19-0	18-9	18-8	18-7	18-6	18-5	18-4	18-3	18-2	18-1	18-0	17-9	17-8	17-7	17-6	17-5	17-4	17-3	17-2	17-1	17-0	16-9	16-8	16-7	16-6	16-5	16-4	16-3	16-2	16-1	16-0	15-9	15-8	15-7	15-6	15-5	15-4	15-3	15-2	15-1	15-0	14-9	14-8	14-7	14-6	14-5	14-4	14-3	14-2	14-1	14-0	13-9	13-8	13-7	13-6	13-5	13-4	13-3	13-2	13-1	13-0	12-9	12-8	12-7	12-6	12-5	12-4	12-3	12-2	12-1	12-0	11-9	11-8	11-7	11-6	11-5	11-4	11-3	11-2	11-1	11-0	10-9	10-8	10-7	10-6	10-5	10-4	10-3	10-2	10-1	10-0	9-9	9-8	9-7	9-6	9-5	9-4	9-3	9-2	9-1	9-0	8-9	8-8	8-7	8-6	8-5	8-4	8-3	8-2	8-1	8-0	7-9	7-8	7-7	7-6	7-5	7-4	7-3	7-2	7-1	7-0	6-9	6-8	6-7	6-6	6-5	6-4	6-3	6-2	6-1	6-0	5-9	5-8	5-7	5-6	5-5	5-4	5-3	5-2	5-1	5-0	4-9	4-8	4-7	4-6	4-5	4-4	4-3	4-2	4-1	4-0	3-9	3-8	3-7	3-6	3-5	3-4	3-3	3-2	3-1	3-0	2-9	2-8	2-7	2-6	2-5	2-4	2-3	2-2	2-1	2-0	1-9	1-8	1-7	1-6	1-5	1-4	1-3	1-2	1-1	1-0	0-9	0-8	0-7	0-6	0-5	0-4	0-3	0-2	0-1	0-0																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	78

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3271.	3271.	984.	118021.
CM5	93.	87.	5M	3342.
INCHES		1.66	4.94	5.96
Hg		47.12	126.62	151.39
AC-F-T		1518.	4079.	4877.
THOUS CLN		1H72.	5031.	6016.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3271. 93.	JULY 1. 6/1.	2057. 3M1.	948. 28.	118021. 33421.
CMHS					5-98
IMHS					151-39
MW					6877.
AC-F					6016.
THOUS CUS					

HYDROGRAPH MOUNTING

WATER FLOW, INCHES, IN HOUR, PERIOD							NO.DA	JPHI	I NAME	I STAGE	I AUTO
	IN 1 Hr.	IN 10 Hrs.	IN 24 Hr.	SECUN	STAPL	ROUTING DATA	0	0	0	0	0
QLOSS	CLASS	Avg	Int S	ISAME	10P7	10P7	0	0	LSTN	0	0
0.0	0.0	0.00	0.00	1	1	1	0	0			
NSTPS	NSTUL	LAG	AMSAK	A	TSK	STOMA	ISPRAT	-1W.	-1		
1	0	0	0.000	0.000	0.000	0.000	-1W.				
STAGE	10.0	19.0	19.0	20.0	21.0	21.0	22.0	23.0	24.0	24.5	
20.0	20.0	25.0	26.3								
FLOW	0.	33.	175.	222.	497.	662.	707.	1026.	1429.	1631.	
1000.	1000.	2349.	4159.								
CAPACITY	0.	397.	982.	1360.							
ELEVATION	0.	20.	25.	28.							
CREL	SPWID	CUGW	EXPW	ELEV	COOL	CAREA	EXPL	0.0	0.0	0.0	
10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
STATION	DAM DATA										
	TOPEL	CNUD	EXPO	DAMID							
	24.0	0.0	0.0	0.							
STATION 2. PLAN 1. RATIO 1											
END-OF-PERIOD HYDROGRAPH ORDINATES											
NO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE				
1.01	0.30	1	.50	0	0	0	18.0				
1.01	1.00	2	1.00	0	0	0	18.0				
1.01	1.30	3	1.50	0	0	0	18.0				
1.01	2.00	4	2.00	0	0	0	18.0				
1.01	2.30	5	2.50	0	0	0	18.0				
1.01	3.00	6	3.00	0	0	0	18.0				
1.01	3.30	7	3.50	0	0	0	18.0				
1.01	4.00	8	4.00	0	0	0	18.0				
1.01	4.30	9	4.50	0	0	0	18.0				
1.01	5.00	10	5.00	0	0	0	18.0				
1.01	5.30	11	5.50	0	0	0	18.0				
1.01	6.00	12	6.00	0	0	0	18.0				
1.01	6.30	13	6.50	0	0	0	18.0				
1.01	7.00	14	7.00	0	0	0	18.0				
1.01	7.30	15	7.50	0	0	0	18.0				
1.01	8.00	16	8.00	0	0	0	18.0				
1.01	8.30	17	8.50	0	0	0	18.0				
1.01	9.00	18	9.00	2	0	0	18.0				
1.01	9.30	19	9.50	6	0	0	18.0				
1.01	10.00	20	10.00	13	0	0	18.0				
1.01	10.30	21	10.50	25	0	0	18.0				
1.01	11.00	22	11.00	44	0	0	18.0				
1.01	11.30	23	11.50	71	0	0	18.0				
1.01	12.00	24	12.00	132	0	0	18.0				
1.01	12.30	25	12.50	246	0	0	18.0				
1.01	13.00	26	13.00	405	0	0	19.0				
1.01	13.30	27	13.50	596	0	0	19.0				
1.01	14.00	28	14.00	114	0	0	19.0				

1.01	14.49	16.50	19.50	312.	435.	20.3	20.6	20.6	20.6
1.01	15.00	30	35	392.	392.	669.	669.	669.	669.
1.01	15.30	31	35	1575.	1575.	511.	511.	511.	511.
1.01	15.00	32	30	10.00	10.00	577.	559.	559.	559.
1.01	16.30	33	30	10.50	10.50	2126.	616.	2126.	2126.
1.01	17.00	34	36	1.00	2362.	634.	678.	678.	678.
1.01	17.30	35	37	17.50	2612.	1011.	743.	743.	743.
1.01	15.00	36	36	16.00	2612.	1234.	888.	888.	888.
1.01	14.36	37	37	16.50	29980.	1457.	872.	872.	872.
1.01	14.00	38	38	16.00	1113.	1707.	933.	933.	933.
1.01	15.30	39	39	19.50	3210.	2110.	985.	985.	985.
1.01	20.00	40	40	20.00	3266.	2645.	1020.	1020.	1020.
1.01	20.30	41	41	20.50	3271.	2904.	1041.	1041.	1041.
1.01	21.00	42	42	21.00	3223.	3047.	1052.	1052.	1052.
1.01	21.30	43	43	21.50	3164.	3105.	1056.	1056.	1056.
1.01	22.00	44	44	22.00	3067.	3106.	1057.	1057.	1057.
1.01	22.30	45	45	22.50	2962.	3076.	1056.	1056.	1056.
1.01	23.00	46	46	23.00	2846.	3017.	1050.	1050.	1050.
1.01	23.30	47	47	23.50	2810.	2949.	1044.	1044.	1044.
1.01	0.00	48	48	26.00	2724.	2873.	1038.	1038.	1038.
1.01	0.02	49	49	24.50	2639.	2794.	1032.	1032.	1032.
1.01	1.00	50	50	25.00	2554.	2711.	1025.	1025.	1025.
1.01	1.30	51	51	25.50	2476.	2628.	1019.	1019.	1019.
1.01	1.30	52	1	0.000	2.525E+01	-1.007E+02	2.526E+01	1.760E+02	1.760E+02
ITERATIVE SOLUTION DID NOT CONVERGE									
1.01	2.00	52	26.00	2387.	2582.	1015.	1015.	1015.	1015.
1.01	2.30	53	26.50	2305.	2357.	1016.	1016.	1016.	1016.
1.01	3.00	54	27.00	2225.	2326.	1007.	1007.	1007.	1007.
1.01	3.30	55	27.50	2145.	2279.	1002.	1002.	1002.	1002.
1.01	4.00	56	28.00	2067.	2222.	996.	996.	996.	996.
1.01	4.30	57	28.50	1989.	215H.	990.	990.	990.	990.
1.01	5.00	58	29.00	1413.	2089.	983.	983.	983.	983.
1.01	5.30	59	29.50	1639.	2014.	975.	975.	975.	975.
1.01	6.00	60	30.00	1766.	1939.	968.	968.	968.	968.
1.01	6.30	61	30.50	1645.	1865.	961.	961.	961.	961.
1.01	7.00	62	31.00	1626.	1811.	954.	954.	954.	954.
1.01	7.30	63	31.50	1559.	1770.	945.	945.	945.	945.
1.01	8.00	64	32.00	1496.	1724.	936.	936.	936.	936.
1.01	8.30	65	32.50	1631.	1675.	927.	927.	927.	927.
1.01	9.00	66	33.00	1576.	1626.	916.	916.	916.	916.
1.01	9.30	67	33.50	1312.	1584.	905.	905.	905.	905.
1.01	10.00	68	34.00	1256.	1540.	896.	896.	896.	896.
1.01	10.30	69	34.50	1202.	1494.	882.	882.	882.	882.
1.01	11.00	70	35.00	1151.	1467.	870.	870.	870.	870.
1.01	11.30	71	35.50	1102.	1403.	857.	857.	857.	857.
1.01	12.00	72	36.00	1055.	1360.	845.	845.	845.	845.
1.01	12.30	73	36.50	1010.	1317.	832.	832.	832.	832.
1.01	13.00	74	37.00	967.	1273.	820.	820.	820.	820.
1.01	13.30	75	37.50	926.	1230.	807.	807.	807.	807.
1.01	14.00	76	38.00	887.	1187.	795.	795.	795.	795.
1.01	14.30	77	38.50	849.	1144.	782.	782.	782.	782.
1.01	15.00	78	39.00	813.	1103.	770.	770.	770.	770.
1.01	15.30	79	39.50	776.	1062.	758.	758.	758.	758.
1.01	15.00	80	40.00	745.	1023.	747.	747.	747.	747.
1.01	15.30	81	40.50	713.	991.	735.	735.	735.	735.
1.01	16.00	82	41.00	683.	960.	724.	724.	724.	724.
1.01	17.00	83	41.50	656.	924.	701.	701.	701.	701.
1.01	17.30	84	42.00	626.	898.	699.	699.	699.	699.
1.01	18.00	85	42.50	599.	869.	669.	669.	669.	669.

PEAK SURGE IS 31119 AT TIME 22:00 MINUTES

P E A K	6-100W	24-100W	72-100W	TOTAL VOLW
C F S	3106*	2402*	1935*	973*
C M S	88*	82*	25*	28*
I N C H E S				33*
M Y	44.00	1.76	4.69	5.90
A L - F I	14.54	14.54	119.14	149.77
T-H-NS LU	1175	1175	38.5h.	4482.5
N			4734*	5951*

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PEAK FLOW AND STAGE: (Elevation of peak flow) upstream from multiple plan-majlo economic computations
Flow in cubic feet per second (cubic meters per second)
Area in square miles (square kilometers)

OPERATION	STATION	AREA	RATIO		RATIO APPLIED TO FLOWS
			PLAN	MAJLO	
HYDROGRAPH AT	1	15.35 39.76	1	3471. 92.621	
ROUTED TO	2	15.35 39.76	1	3106. 87.451	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OFT LOW	INITIAL VALUE IN. GROSS SHEAR 0.	SPILLWAY CREST 16.00 340. 0.	TOP OF DAM 24.49 912. 1609.	TIME OF FAILURE HOURS
HALO OF DWF	MAXIMUM WATERVOLUME W.S. SLEEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS
1.00	25.50	1.14	1057.	3106.	14.50
					22.00
					0.00